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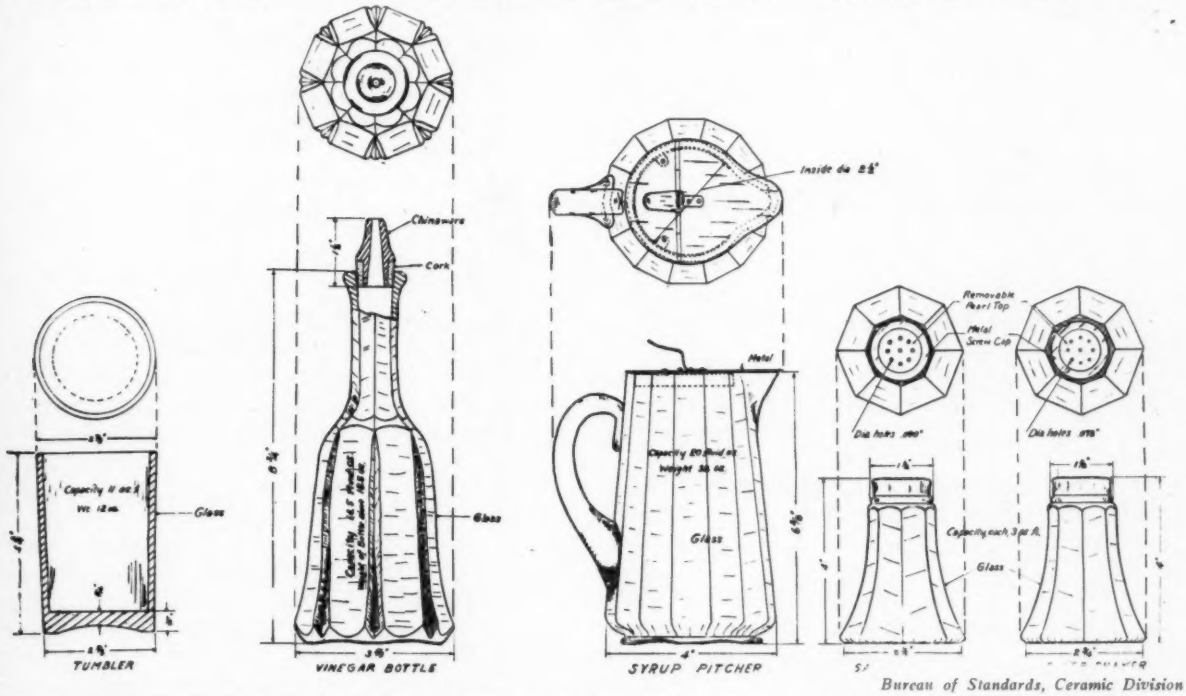
Government Specification for Glass Tableware

Federal Specifications Board Standard Specification No. 121

This specification was officially adopted by the Federal Specifications Board on February 20, 1924, for the mandatory use of the War Department, Navy Department and Marine Corps, and for the optional use of the other Departments and independent establishments of the Government in the purchase of glass tableware.

The latest date on which this specification shall become mandatory for the War Department, Navy Department and Marine Corps, is May 20, 1924. The specification may be put into effect, however, at any earlier date if desired.



Bureau of Standards, Ceramic Division

RESTRICTED LIST OF GLASS ARTICLES FOR USE IN ENLISTED MEN'S SERVICE—ARMY, NAVY AND MARINE CORPS

Designation

Articles covered in these specifications are used for tableware purposes. They shall be classed in two grades, blown or pressed ware and cut ware.

Material

BLOWN OR PRESSED WARE—shall be made from either a lime or a lead flint glass, which may be melted in a pot or tank and may be either hand or machine made.

CUT WARE—shall be made from a lead silica alkali glass commonly known as lead crystal. It shall contain not less than 30 per cent of lead oxide and have a specific gravity not less than 3.0.

Requirements

PRESSED AND BLOWN WARE may show faint color and have a few scattered bubbles (not exceeding 5/100 inch in diameter) providing the glass is of what is generally considered as good color and the defects do not damage the appearance of the ware. Surfaces shall be fire polished enough to eliminate dullness.

Glass shall be of such composition and so well annealed

that articles will pass the shock test and boiling test without showing any indications of corrosion, chipping, scumming or cracking.

CUT WARE—Ware shall be cut on a wheel from smooth blanks and all of the exterior surface shall be smoothed and polished, including scallops and notches. The interior of the blanks must be protected from acid during manufacture.

Glass shall be of such composition and so well annealed that it will withstand the boiling test without showing any chipping, scumming or cracking, and shall be tested for specific gravity.

All tableware shall be free from heavy cords, stones and fine cracks. It shall be straight and true so that when rotated about its vertical axis the top edges shall show an eccentricity of less than one-eighth of an inch and the bottoms must be sufficiently plain so that the ware will not rock on a smooth surface. All edges must be properly finished.

Design

Ware shall be furnished conforming to figures shown on drawings of ware adopted for government use or as otherwise indicated in the order, measurements and weights to be within tolerances indicated.

Methods of Testing

BOILING TEST—Articles shall be completely immersed in distilled water in a closed vessel having a small steam vent and boiled continuously for six hours, boiling water being occasionally added to compensate for evaporation losses. The article shall be suspended in the water so that it does not come in contact with the containing vessel.

Any article which shows corrosion, scumming, chipping or cracking as a result of the boiling shall be considered as having failed to pass the test.

SHOCK TEST FOR TABLEWARE—Articles shall be immersed in tap water 16 deg. to 21 deg. C. (60 deg. to 70 deg. F.), allowed to remain ten minutes, then transferred suddenly into boiling water. This operation shall be repeated five times. Cracking of the article during the tests shall be considered as a failure.

DETERMINATION OF SPECIFIC GRAVITY—Article shall be dried at room temperature and weighed. It shall then be weighed suspended in water completely immersed. Very light cord or thread shall be used for suspending the article, depending upon its weight. Specific gravity may be calculated from the formula:

$$\frac{\text{dry weight}}{\text{dry weight—suspended weight}} = \text{specific gravity}$$

The entire article or broken portions of it may be used for this test. Weighing shall be done accurately to at least one-tenth per cent of the total weight.

Sampling

In shipments of ten dozen or less of any shape, two articles of that shape shall be selected at random for test. For shipments of over ten dozen, two samples for each ten dozen or fraction thereof shall be selected for test.

Failure of any type of article to pass any of the requirements shall be considered as a basis of rejection of the article.

If all samples taken pass the requirements, the order shall be accepted; if any one type of articles, such as tumblers or vinegar bottles, pass the requirements, but another type fails to pass, that portion of the order which passes shall be accepted, and that portion failing to pass shall be rejected.

Recommended Sizes for Milk and Cream Bottles

The wastes resulting from the excessive number of types of milk and cream bottles and from the variations in diameter of caps for these bottles, prompted the industries concerned to avail themselves of the facilities of the Division of Simplified Practice of the Department of Commerce in effecting a substantial reduction in the diversity of these commodities.

The preliminary conference of manufacturers, held at the department on June 26, 1922, decided that a survey of the field to determine the existing variations should be made as a basis for eliminations at a general conference to be called at a later date.

Upon completion of the survey early in 1923 a general conference was called by the department for March 6, and in response to the invitation representatives of manufacturers, distributors, and consumers assembled to adopt a sound and conservative policy tending toward the betterment of their individual businesses and the industry as a whole.

Discussion centered chiefly upon the eagerness of one group to simplify each capacity of milk and cream bottle to a single variety, but the majority felt that the intent and purpose of the conference would be defeated if they attempted to go so far in the initial step.

The importance of unanimous action regarding the recommendations of the conference was strongly emphasized and resulted in an agreement to eliminate the quarter-pint size and to adopt as a preliminary step three varieties each of quart, pint, and half-pint bottles and a single diameter of cap, as shown in Tables 1 and 2 of this report, as their standard of practice for the ensuing year, commencing January 1, 1924.

The data collected through the survey mentioned heretofore showed that quart bottles were being manufactured in 12 varieties, pint bottles in 13 varieties, half-pint bottles in 14 varieties, quarter-pint bottles in 10 varieties, and caps to fit the various bottles were being made in 10 diameters. The reduction to a total of 9 varieties of bottles, each having the same diameter of cap seat, proves beyond doubt the value of the movement and the resulting benefits accruing to all groups concerned.

A brief analysis of the replies of 15 bottle manufacturers accepting this recommendation shows that economic advantages, such as fewer molds and lower cost for replacement, lower production costs, greater interchangeability, greater labor efficiency, and standardized equipment will result from the adoption of this constructive program.

The recommendation has been accepted by the International Milk Dealers' Association, National Bottle Manufacturers' Association of the United States, Cap Manufac-

turers' Credit Association and the Glass Container Association.

Simplified Practice Recommendation No. 10

MILK AND CREAM BOTTLES AND BOTTLE CAPS

In accordance with the unanimous action of the joint conference of representatives of manufacturers, distributors, and certain users, the United States Department of Commerce through the Bureau of Standards, recommends that in respect to bottles used in the sale of milk and cream the quarter-pint size be eliminated, and that the recognized varieties of bottles of a capacity of 1 quart, 1 pint, and one-half pint, and of the caps for such bottles, be reduced to those shown in the following table:

TABLE 1.—SIZES OF MILK AND CREAM BOTTLES

Capacity.	Overall height		
	Inches	Inches	Inches
Quarts	9	9¼	9½
Pints	7⅛	7¼	7½
Half pints	5¼	5⅜	5½

TABLE 2.—SIZES OF MILK AND CREAM BOTTLE CAPS[1]

Size Number	Die Inches	Thickness of paper board. Inches
No. 2	1 21/32	0.035 to 0.040

[1]One size cap will meet the requirements for the nine varieties of bottles shown in Table 1.

Jena Glass*

By Dr. Thiene

Whoever is traveling towards the city of Jena from the north on the Saal Railroad cannot fail to observe in the southern part of the city a large factory surmounted by fourteen large chimneys. Here a product is manufactured known the world over as Jena glass, in the Jena Glass Works of Schott and Company. What is it that distinguishes the Jena Glass Works from other industrial enterprises? Before the momentous investigations of Abbe and Schott, only two kinds of glass were known: the ordinary lime-alkali-silicate glass used for window glass, table glass, hollow ware, and the better potash-lead-silicate glass for crystal and flint glass. Through some laboratory experiments of Guinaud, Harcourt, and others, the possibility had been recognized to introduce other materials into glass. But it is due to the scientific work of Professor Dr. Ernst Abbe and Dr. Otto Schott which was begun at the end of the seventies that an entirely new and wide field was opened up for the glass industry. These investigators showed that besides the elements used heretofore a large number of other substances can be used, and that with the change of the substance introduced the chemical, mechanical, thermal, electrical and optical properties of glass are changed more or less strongly. The most important compounds of the new Jena glasses are the salts of boric acid, phosphates and fluorides.

After the foundation for a new glass industry had been laid through laboratory experiments, Abbe, Schott and Zeiss founded in the year 1884 the Jena Glass Works with a capital of 60,000 marks. The same amount was contributed by the Prussian government which had a deep interest in the improvement of optical and thermometer glass. To these tasks which were the immediate objects of the foundation of the glass works others were added in a short time and they increased from year to year. All Jena glasses are special glasses, which are made with direct reference to the ultimate use. If several requirements are demanded at the same time, as for instance chemical glassware (thermal and chemical), the one property is not emphasized at the expense of the other, but a medium is arrived at, which is the most appropriate for the use to which the glass will be put. The number of Jena glasses has been raised to about 200, in accordance with the different demands. Extensive precautions are taken to prevent mistakes in the preparation of the batch. The different raw materials are in silos from which they are drawn off into cars, so that at all times the weights can be tested. When the raw materials needed for a batch are weighed they are well mixed mechanically.

Besides the glass manufacturing department the works have two electrical power stations, a clay factory (mill, pot and stone rooms), a machine shop, a chemical factory, a paper mill, a steam driven saw mill with box factory and a gas works.

The glass department is conducted in five divisions. 1. Illuminating ware and hollow ware. 2. Chemical glass ware. 3. Glass tubing. 4. Optical glass. 5. Electrical glass ware.

The greatest diversity in composition occurs in the optical glasses of which there are far over a hundred different kinds. They should be first of all free from internal stresses and free from cords, colorless and resistant against the action of air. The novel feature of Jena optical glass lies mainly in the relation between refraction and dispersion. Whereas with the old crown and flint glasses the dispersion increased directly with the refraction, there are Jena glasses with equal refraction and different degrees of dispersion and vice versa. Of the many new glasses with which the optician was able to solve a number of problems, the following may be mentioned: Jena prism-crown and flint for field glasses (especially resistant and free from color); Jena barium flint and the heaviest barium crown (for photographic objectives); Jena borate, phosphate and fluoride glasses (for microscope lenses); Jena spectacle glasses (very colorless, hard and resistant against wet air); Jena Tempax glass (for illuminating lenses, especially resistant against high temperatures); Jena UV-glasses with increased permeability to ultraviolet rays, Jena glasses for light filters (red, yellow, green and blue filters); Uvonglass (for the absorption of ultraviolet light); Robax glass (heat absorption filter); Fluorescent shields; glasses protective against Roentgen rays.

Next to the optical glasses, the greatest diversity of composition is in the tube glasses. To prevent confusion the most frequently used tube glasses have a lengthwise stripe differently colored for each kind of glass. The oldest and best known is the Jena Normal glass 16III (with wine-red stripe) which differs from the older thermometer glasses through its very small thermal after effect (nearly unchangeable zero-point). Thermometers made of 16III can be used up to 450°

*Keramische Rundschau, Vol. 32, pp. 66-68. Translated for THE GLASS INDUSTRY.

C. In higher temperatures the Borosilicate glass 59III (up to 510° C.) and the Jena combustion glass (up to 575° C.) are used; the Supremax glass can even be used at as high as 675° C.

The advances in the construction of machinery put new problems before the glass works. The ordinary gauge glasses were no longer suitable for the increased requirements. The Jena gauge glasses—Felsenglass (with blue stripe), Durobax (with red stripe)—are so resistant against steam pressure, sudden changes in temperature and the solvent action of boiler water and superheated steam that the former can be used for pressures up to 20 atmospheres, the latter up to 30 atmospheres. Lately for the same purpose Jena Maxosplates have been used which distinguish themselves through slight solubility and high thermal resistance.

The custom to dispense certain medicines in solution in definite doses, the so-called vials or ampules could not have been developed to such an extent if not the Jena vial glasses, white Fiolax glass (with black stripe) brown Fiolax glass (with white stripe) had made it possible, owing to its very low alkali content to sterilize and preserve the most sensitive solutions (e.g. morphine, hypophyse, etc.).

Another line of glassware which is being manufactured is combustion tubing and reagent glasses for chemical laboratories, glasses for leading-in wires of metals (tungsten, molybdenum, platinum), glasses to make a junction between glasses of different coefficients of expansion.

To every chemist are known beakers, flasks, dishes, etc., of Jena chemical glassware. Its excellence is due to high resistance against sudden changes of temperature and to slight solubility, which makes it indispensable for accurate analytical work.

The dependence of a new industry upon glass was never shown in a more striking way than in connection with the introduction of Auer light. After all the difficulties in obtaining the rare earths to make incandescent mantles had been overcome, the lack of resistance of the glass lamp chimneys threatened to undo all previous efforts. All experiments to replace the old glass lamp-chimneys by those made of mica or other substitutes were in vain. The introduction of the Auer light would have failed if not Schott in the year 1893 had created a new glass through the introduction of boric acid. The glass satisfied every demand in every respect. The new Jena glass chimneys—Jena Supraxglass—do not only withstand the action of flames which occur when the incandescent mantle has been damaged, but it is possible to sprinkle cold water on them, without cracking the glass.

In this division are made further: Jena glasses for miners lamps (high thermal and mechanical resistance); Jena milk glasses (even dispersion of light with slight absorption); Robaxglass for milk bottles, tea glasses and thermos bottles (resistant against sudden changes in temperature); Durax glass for baking dishes as substitute for porcelain and stoneware.

In the electrical glassware division, the youngest of the five divisions, electric meters for direct current are built, the essential part of which is a voltmeter cell made of special glass. Its principal advantage is the absence of moving parts, and permanent accuracy even with the smallest currents. The special glass, mentioned under glass tubing for the leading-in wires of molybdenum is also used for the manufacture of transformers in which alternating currents up to 150 KW and 250 Amperes are changed into direct current. The scarcity of mica during the war has been the incentive to the development of Minosglass. The demands for a good dielectric, viz., high insulating power, low conductibility and slight losses on the electric alternating field, are met in the most favorable way in the Minosglass. Bottles and plate condensers of from 200 to 60,000 cubic centimeters, for as high as 80,000 volts are made; they have found wide application in wireless telegraphy and for diathermic apparatus.

American Chemical Society Meeting

The sixty-seventh meeting of the American Chemical Society was held at Washington, D. C., during the week beginning April 21. Many papers on a wide variety of subjects were read before the various divisions, including those reviewed below.

Loss of Heat from Furnace Walls

By R. Calvert and Lyle Caldwell

While the conductivity of a certain insulating brick is found to be the same by the box test and by the guard-ring method, the latter procedure is recommended. Conductivity-temperature charts are given for various insulators. For a certain insulating powder, the conductivity is greater at the higher densities, but this effect becomes less at the higher temperatures. Tests on a three-layer wall, each wall containing a different kind of brick, showed that the temperature gradient calculated from the known conductivities checked closely with the values actually indicated by thermocouples, the interfacial resistance being a small proportion of the total resistance. When one of the layers of brick was omitted, the heat loss was more than doubled.

Researches on Glass at the Bureau of Standards

By P. H. Bates

The work on glass at the Bureau of Standards has been carried on since about 1913. For the first half of this period practically all of the facilities were devoted to the production of optical glass for use by the Navy. This phase of the work is still being continued. The major part of the research work so far has been in reference to optical glass alone. During the past three years the work has, however, been extended to what may be called commercial glasses, and research work is now under way under the following heads:

1. Annealing.
2. Viscosity of glass at the melting and molding temperatures.
3. Weathering or durability of glass under various conditions of service.
4. Opalescence in glass; particularly as to what causes opalescence.
5. The cause of stones in glass.
6. The study of pot and tank block refractories.
7. Specifications for different types of glass products and for the raw materials entering into glass.
8. The development of the refined method of analysis.

The Microscopic Identification of Stones in Glass*

By Herbert Insley

ABSTRACT

For the identification of stones in glass, it is not only necessary to observe the external form of the crystalline substances forming the stones, but also to determine their optical properties by means of the polarizing microscope.

A brief description of the method of preparation of stones for microscopic examination is given.

The principal optical properties and distinguishing characteristics of the crystalline substances occurring in stones in the soda-lime glasses are noted.

INTRODUCTION

Bowen[1] has pointed out that, because of their crystalline nature, stones in glass may be readily identified by means of the polarizing microscope. He has also shown that the source of the stone is indicated by the composition and structure of the crystals, and he has given the optical properties of the stones found in optical glass. In a recent paper, the writer[2] has shown that the stones occurring in tank glasses, although in part of different compositions from those found in pot glasses, can also be identified and traced to their sources by the use of the polarizing microscope.

The impression seems to have been left with glass technologists that stones could be identified by their external form alone. Many crystalline compounds have widely differing compositions, although very similar in external form, and it is, therefore, necessary to determine the optical properties before satisfactory identification can be made. The object of the present paper is to note the methods of examination and to give the distinguishing properties of the crystalline compounds occurring in the soda-lime glasses.

A knowledge of the composition of stones in glass should enable the plant technologist to eliminate them since he already has information on the batch composition, the temperature conditions in the tank and the condition of the tank walls. The polarizing microscope affords him a means of determining the composition of the crystalline parts of the stones which is more exact and more rapid than that of chemical analysis. A working knowledge of the methods of determining the optical properties of crystalline materials is, of course, essential to the efficient use of the polarizing microscope.[3]

One of the most important properties to be determined is the index of refraction. To make this determination, it is necessary to crush the specimen to a powder and immerse in liquids of known index of refraction. Before crushing, the stone should be freed from the surrounding glass as much as possible. This can be done by breaking the glass containing the stone into fragments one-sixteenth to one-thirty-second of an inch in diameter and separating the stony material from the clear glass by means of a probe under the binocular microscope. All of the optical properties may be determined by the use of the immersion method, but for the preservation of typical stones and for the observation of structure thin sections are very valuable.

The source of the stone is sometimes indicated by its manner of occurrence. Stones derived from the tank walls are frequently accompanied by lumps in the finished glass. Grains of undissolved sand may be altered wholly or in part to the high temperature modifications of silica and may frequently be surrounded by devitrification crystals of tridymite. Other undissolved batch constituents also may be surrounded by aureoles of devitrified glass, the crystals in the devitrified area having a chemical composition closely related to that of the undissolved batch constituent. Devitrification crystals frequently occur as radiating spherulites or feathery aggregates.

A list of the crystalline compounds occurring in the soda-lime glasses is given below. The optical properties of each compound, the usual habit of the crystals, their associations, the different types of stones in which they occur, and the properties most useful for distinguishing them from other crystalline materials in glass are also noted.

QUARTZ.—(SiO_2)—Stable below 870°C. Usually occurs as grains with rounded and sometimes embayed faces. Crystals with well developed faces are seldom, if ever, seen in stones. Its indices of refraction are: $\omega = 1.544$, $\epsilon = 1.553$, and it is uniaxial positive in optical character. It has no recognizable cleavage. Its characteristic properties are its indices of refraction, its double refraction, the shape of the grains and its associations. Quartz has never been observed as a crystallization product of the glass and is only found in either batch or tank stones (stones derived from the refractory walls of the tank). In batch stones it is sometimes the only crystalline material, but more usually it is associated with tridymite and cristobalite. In tank stones it is associated with dehydrated clay substance, sillimanite, etc.

TRIDYMITE.—(SiO_2)—Stable between 870° and 1470°C. Tridymite may occur in hexagonal plates or wedge-shaped and interpenetration twins, depending on the mode of formation. Devitrification crystals are usually simple hexagonal plates, crystals resulting from the inversion of quartz grains are usually twinned. The indices of refraction are $\alpha = 1.469$, $\beta = 1.470$, $\gamma = 1.473$. The optical character is biaxial positive and the acute bisectrix is normal to the hexagonal plate. The crystals are probably orthorhombic. The hexagonal plates are most frequently seen turned on edge when they appear as needles or laths with parallel extinction and negative elongation (elongation = α). Plates arranged in parallel layers are abundant.

Tridymite occurs in batch stones where the undissolved

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* *Jl. Amer. Ceram. Soc.*, Vol. 7, No. 1. Published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

[1] N. L. Bowen, "The Identification of Stones in Glass," *Jour. Amer. Ceram. Soc.*, 1, 594-605 (1918).

[2] *Jour. Amer. Ceram. Soc.*, 6 [6], 706-16 (1923).

[3] The following books are of great assistance in understanding the theory of optical crystallography as well as the methods of optical measurement with the microscope: Albert Johannsen, "Manual of Petrographic Methods." Second edition. McGraw-Hill Book Co., 1918. (A complete discussion of theory as well as a compilation of methods); Esper S. Larsen, "The Microscopic Determination of the Nonopaque Minerals," U. S. Geol. Surv., *Bull.* 679 (1921). (Gives a discussion of the immersion method as an introduction to a list of the optical properties of the known minerals); N. H. and A. N. Winchell, "Elements of Optical Mineralogy." 2d ed., Pt. 1. D. Van Nostrand and Co., 1922. (A concise discussion of theory as well as of modern practice); F. E. Wright, "The Methods of Petrographic-Microscopic Research." Carnegie Inst. Washington, *Pub.* 158 (1911). (A discussion of the accuracy and limitations of the methods of optical mineralogy).

constituent is quartz, in devitrification stones, in crown drops and frequently in the scum on the melting surface of tanks. In batch stones it occurs either as hexagonal plates or wedge-shaped twins and is usually associated with quartz and sometimes with cristobalite. The large white spheres so frequently found in devitrified glass sometimes contain hexagonal plates of tridymite arranged irregularly with respect to each other and in a matrix of glass. Under the microscope the plates appear as needles or laths. Tridymite appears as large wedge-shaped or more intricate twins in crown drops and simple hexagonal plates are rarely seen. In scums on the melting surface where the crystallizing constituent is silica, tridymite usually forms the uppermost part of the scum, cristobalite forms the lower layer of the scum and there is a gradual transition between the layer predominantly cristobalite and the layer predominantly tridymite. Tridymite in scums may appear as hexagonal plates, wedge-shaped twins or both. The distinguishing properties of tridymite are the indices of refraction, the character of the elongation of the upturned hexagonal plates, the wedge-shaped twins and the crystalline materials with which it is associated.

CRISTOBALITE.—(SiO_2)—Although cristobalite's stability range is from 1470°C to its melting point, it appears at temperatures which are considerably less than 1470°. It very often is the intermediate crystalline form of silica in the inversion of quartz to tridymite and it sometimes crystallizes directly from the melt at temperatures below 1470°. Cristobalite most frequently appears as very small skeleton crystals[4] arranged in parallel growths. Complete crystals have never been observed in glass by the writer. The indices of refraction of cristobalite are about 1.484 and 1.487 and the double refraction is very low. Cristobalite occurs in batch stones associated with tridymite and undissolved quartz grains, in scums on the melting surface associated with tridymite, and in devitrification crystals. In devitrification crystals the pine-tree growths are characteristic.[5] Cristobalite is readily identified by its index of refraction and characteristic skeleton crystals and parallel growths.

WOLLASTONITE.—($CaO.SiO_2$)—Wollastonite is monoclinic with its elongation parallel to the crystallographic b axis and consequently it appears to have parallel extinction. It occurs in laths or needles. Since the vibration direction β is parallel to the elongation, the elongation may be positive or negative, but due to the fact that the index of refraction β is very much closer to γ than it is to α, the elongation usually appears positive. The indices of refraction are $\alpha = 1.616$, $\beta = 1.629$, $\gamma = 1.631$. The optical character is biaxial negative. Wollastonite occurs only as a devitrification product and usually as radiating feathery or spherulitic aggregates. Wollastonite may be distinguished from sillimanite by its slightly lower indices of refraction, its habit and the fact that the laths are somewhat broader than the sillimanite needles. It may be distinguished from diopside by its lower indices of refraction and its parallel extinction.

DIOPSIDE.—($CaO.MgO.2SiO_2$)—Diopside has been observed in two instances by the writer, once as a devitrification spherulite and once as the crystalline constituent of the scum on the melting surface of a tank. In both cases the limestone used in the batch was dolomitic. Diopside can evidently only occur as a devitrification product where magnesian limestone or some magnesia compound is used in the batch.

Diopside occurs in slender prismatic crystals with a maximum extinction angle of about 40°C. The indices of refraction are $\alpha = 1.673$, $\beta = 1.680$, and $\gamma = 1.702$.[6] It is biaxial positive in optical character. Diopside is easily distinguished from other crystalline compounds in glass by its indices of refraction and its extinction angle.

SODIUM-CALCIUM SILICATE. The exact formula of this compound is not known. It occurs in slender crystals as a devitrification product. The prismatic crystals have a hexagonal or octagonal cross-section. The indices of refraction are $\alpha = 1.562$, $\gamma = 1.577$[7] and the optical character is biaxial positive. The extinction is parallel and the elongation is positive ($= \gamma$). The indices of refraction, habit, and character of elongation are sufficient to distinguish this material from other crystals occurring in glass.

SILLIMANITE.—($Al_2O_3.SiO_2$)—Sillimanite is found only in stones derived from the pot or tank walls. It occurs in orthorhombic needles and slender laths which have a characteristic appearance. Its indices of refraction are: $\alpha = 1.638$, $\beta = 1.642$, $\gamma = 1.653$. Sillimanite has parallel extinction and positive elongation ($= \gamma$). It is very frequently associated with dehydrated clay that has not dissolved in the glass or transformed to sillimanite and is sometimes associated with quartz grains or corundum crystals. Sillimanite can be identified by its indices of refraction, crystal habit, extinction and character of elongation.

CORUNDUM.—(Al_2O_3)—Stones containing corundum have, without doubt, been derived from the refractory walls of the pot or tank. Corundum crystals, as they occur in glass, are very thin, hexagonal plates. The indices of refraction are: $\omega = 1.768$, $\epsilon = 1.760$ and the optical character is uniaxial negative. The double refraction is so low and the plates are usually so thin that interference figures are very faint. The hexagonal plates turned on edge appear as very fine needles with positive elongation. Corundum crystals, which are small (0.002-0.08 mm.) have rounded edges and are associated with clouds of fine-grained amorphous particles, have probably been derived from refractory material below the glass line which contained a high percentage of alumina. Larger corundum plates (0.1-2.0 mm.) which have well defined edges and are not associated with fine-grained amorphous particles have been produced by the action of the soda in the furnace atmosphere upon flux blocks above the glass line. The index of refraction and the crystal form of corundum are usually sufficient to distinguish it from other materials occurring in stones.

NEPHELITE.—($Na_2O.Al_2O_3.2SiO_2$)—Nephelite has been frequently found by the writer in flux blocks above the glass line which has been exposed to the soda in the furnace atmosphere, but it has been found in a stone in glass in only one case. Here it was associated with corundum and was evidently formed by the action of the molten glass on the

[4] Fenner, *Amer. Jour. Science*, 36 [4], 355 (1916).
[5] *Jour. Amer. Ceram. Soc.*, 6, 708 (1923).
[6] The indices given were determined on crystals occurring in a scum on the melting surface of a tank. They are somewhat higher than those given for pure artificial diopside by Wright and Larsen, *Am. Jour. Sci.*, 27, 1 (1909).
[7] Indices were determined by the writer.

corundum under unusual conditions. In thin section the nephelite crystals had a hexagonal cross-section and showed a faint but unmistakable uniaxial negative interference figure. The double refraction was very low, and the index of refraction was slightly less than that of Canada balsam (about 1.54).

AMORPHOUS SUBSTANCES.—Pot or tank stones very often contain what appear to be opaque masses under low power, but are in reality clouds of very fine, apparently amorphous particles which have resulted from the dehydration and dissociation of the clay minerals. Identification of such masses would be very difficult except that they are almost always associated with masses of sillimanite needles and with rounded and partially dissolved quartz grains.

When salt cake or calcined alumina is used in the glass batch, large stones containing balls of these undissolved materials are sometimes formed. Since the particles making up such stones are very fine and amorphous, identification by means of the microscope is impossible and it is necessary to resort to chemical analysis. Fortunately, stones of this type are usually large and are easily separated from the surrounding glass.

The Decoration of Table and Fancy Glassware

In a lecture on the Decoration of Table and Fancy Glassware given recently in London under the auspices of the Pottery and Glass Trades Benevolent Institution, the lecturer, Mr. Y. Kny, gave an interesting description of the methods used in England for glass cutting, engraving, acid polishing and other operations. Part of Mr. Kny's address, as reported in the *Pottery Gazette and Glass Trade Review*, follows:

Cutting shops are long buildings, generally built on the ground floor, and lit with skylights in the lower part of the roof on each side. The light is thus thrown down from above on the work in hand. Down the center of the shop, and attached to beams across the roof, runs a long iron shafting, with cones or pulleys at intervals connected by means of leather belts running alternately to the right and left, with the spindles fixed in the cutters' frames. A cutting frame consists of a wooden frame supporting an iron or wooden oblong trough, on either side of which runs up a strong post, and these carry the blocks in which the iron spindles run. The spindles, on which the iron or stone wheels are fixed, are interchangeable, and carry on one side a pulley for the belt from the overhead shafting. Pulleys vary in size, and, with the graduated cones on the shafting, control the speed at which the wheel revolves. Please notice all wheels revolve vertically. The motive power driving the shafting was formerly either from a gas or steam engine, but now the electric motor is fast superseding these. There are also two other styles of cutting frames worthy of slight notice. On the Continent, especially in Czecho-Slovakia, a cutting frame is used the wheel of which travels horizontally, and is used in cutting the long flat flutes on cylindrical toilet bottles and other similar goods. In this case, the article to be cut is held on the flat upper surface of the revolving wheel. Frames of this description are used more here for flattening lenses for railway and other lamps. Another frame, now very little used, is built up on a bench about 2 ft. 6 in. high, the glass-cutter standing or sitting on a high stool, and operating this frame by a foot treadle and flywheel underneath the bench. In working, the glass to be decorated is held up to the cutting wheel.

We will now go back to the cutting frame as generally used. The glass-cutter stands or sits behind his frame, brings the glass in contact with the top of the wheel, and in such a way that he can see through the article in hand. By varying the pressure, he regulates the depth of the cut. Hanging from a beam overhead, in a line with the wheel, is a hopper, containing either sand and water or water only. The wheels for the actual work of cutting are of two materials. Iron wheels, or mills, fed from the hopper with sand and water, and used for roughing out the design, vary in size from 4 in. to 22 in. in diameter, and in thickness from ⅛ inch upwards. Stone wheels, varying in size and thickness, similar to the iron wheels, are used for smoothing out the work, and are fed from the hopper with water only. All wheels must be kept perfectly true, and the surface, either round, flat, or mitred, constantly trimmed. Various kinds of stone are used, Craig Leith, blue stones, and manufactured alundum and carborundum wheels. It will be very evident that the shape and strength of the cut will vary with the shape of the cutting face of the wheel. Wheels of varying thicknesses, with a rounded face, cutting ovals varying in width proportionate to the width and roundness of the wheel. Mitre wheels, with a wide, blunt edge, cut a broad mitre, while sharp acute mitres produce fine mitre cuts, and this type of wheel is most generally used in modern cut decoration. Again, wheels with a flat surface are used for flat flutes, etc. Having considered the tools used, we will now proceed with the actual process of decoration.

The article or blank to be decorated is carefully examined, and any slight imperfection noted. In a bowl or article of that description, the bottom is generally flatted on an iron mill and the punty mark removed, so that it stands upright and true. The design is now marked out on the blank with a mixture of red lead and turpentine. At the present time this operation is generally done by girls, who are very expert. The lines that govern the pattern are first drawn, and various widths carefully compassed and divided to ensure accuracy. In decorations that are constantly being repeated, the whole of the work is not marked out, but all lines and points governing the pattern are carefully drawn and noted. The blank is now ready for roughing out on the iron mill. The rougher selects the mill he requires, fixes it in his frame, and, after regulating the speed at which he requires it to travel, and the flow of sand and water from his hopper, he proceeds to rough out with deep, firm cuts the whole of the decoration that can be done with the mill in use. As soon as he has finished with one mill, he removes it from the frame, and, selecting another, proceeds with the design in

hand. This process of changing and selecting suitable wheels continues till the whole of the design is roughed out. During this operation, the rougher constantly dips the article in water, to clear it from the sand that congregates on it.

It must be carefully noted that, in roughing, the work is not cut to its full depth or width, space being left for the smoother to fill up to full strength. The article now proceeds to the smoother, who selects his stones or alundum wheels, similar in shape to the iron mills used by the rougher. After regulating the speed and supply of, in this case, water only from his hopper, he proceeds to smooth in the work. As soon as the whole of the work capable of being smoothed with this wheel is done he changes it, and so proceeds till the whole of the decoration is smoothed in. Great care and technical skill is required in seeing that all mitre cuts, etc., are exactly similar in depth and width, that the points finish exactly as required, and, in the case of mitres touching up to one another, the point of meeting is clear and accurate. All hollows, broad mitres, etc., must be exactly alike in shape, depth and width.

Rings or lines round an article require special care in seeing the cut is continued, and shows no waves or undulations. In this process the work is smoothed up to its full dimensions. It very often happens that certain parts of the decoration are light and delicate, and in this case the work is smoothed in direct on the stone wheel. This also applies to certain patterns on light wines, vases, etc., when, the decoration being light, the whole of the pattern is smoothed in. The article is now ready for polishing.

Until recently this was a long and complicated process, and entailed the whole of the decoration being polished over with wood and cork wheels, similar in size and shape of face to the stone wheel used by the smoother. A mixture of pumice, rotten stone, and water was fed on to the wheels during this process. After this the whole of the article was subjected to a brushing over with brushwheels first fed with pumice and water, and afterwards with putty powder and water, to remove all smears. In cases of light smoothed in patterns, the whole of the polishing was, and is sometimes still, done with brushwheels. Putty powder—a lead oxide used in this process—is very injurious to the health of the workman, and great care must be taken in drawing off, by means of fans, all particles that fly off the wheel or remain in the atmosphere. In the modern, and more generally adopted, method of polishing, this is done by dipping the article in a bath of hydrofluoric and sulphuric acid. There are several routines adopted for this process by different cut-glass manufacturers, all very similar. Generally speaking, the following may be accepted as fairly representative. The acid mixture is prepared and used in a gutta-percha vat under a canopy or fume chamber. Great care is taken in drawing off fumes, otherwise it would be impossible for the operator to work. The polisher is protected with specially made heavy overalls and strong rubber gloves reaching to the elbow. The acid mixture, as you can imagine, is very strong, a single spot on the flesh causing a nasty wound if it is allowed to remain for a little while. Fortunately, a wash of soda or ammonia solution will quickly neutralize the acid. The acid also burns and destroys the overalls, which have to be constantly renewed. The smoothed-in article to be polished is thoroughly washed and carefully examined before it is dipped in the bath, to see that the smoother has taken out in his process all rough parts, and that he has not let his wheel fire in the cuts. If found faulty, the piece is returned to the smoother to be corrected, otherwise imperfections would be magnified in the acid bath, necessitating considerable time being spent in rectifying it in the cutting shop afterwards.

The polisher takes the piece and dips it in the acid bath with one hand, keeping it moving at the same time with a rubber sponge or mop, until the whole of the surface is wiped over. After a certain time, regulated by the strength of the acid, the piece is brought out of the acid and immediately dipped in water, and the whole of the acid carefully washed off. It is then dried and examined. If it is found that any of the work is dull, another bath of shorter duration is given. However much care is taken in this process, occasionally imperfections will appear, which must then be removed in the cutting shop, and the part repaired, brushed, and polished.

The art of glass engraving by means of copper wheels, which is the next process to be considered, is also one that dates back to the early periods of glass manufacture in England. Authentic pieces dating back to 1690 will give a good idea of its antiquity. It is practically certain this art was practised in Bohemia at a much earlier date, and by many that country is looked upon as the birthplace of the art. In recent years, many clever Bohemian exponents of glass engraving have taken up their residence in England. Although the early pieces of this decoration are generally rough and unfinished in workmanship, and the designs more or less crude, occasionally pieces are met with showing a higher standard of skill and design. As in diamond point engraving, many of these old decorations show the influence of the political feeling of that period—Jacobean portraits, mottoes and emblems, Masonic signs, crests and armorial bearings, etc. Some of these old decorations, with slight variations, are still trade designs, notably vine, hop, and barley, etc. For this process, a small lathe with a brass or iron head is used, and the motive power is generally by means of a foot-treadle and flywheel underneath the bench, on the top of which the lathe is firmly screwed. A mandrel of mild steel carries the pulley carrying the band from the flywheel, and the outer end of the mandrel is drilled out to take the lead-cased end of the spindle. Under the outer end of the spindle a copper wheel is carefully riveted and turned so that it runs absolutely true. Spindles are interchangeable, and a lathe may possess any number. A real good lathe for all classes of work will often have 150.

The wheels vary from the size of a pin's head to five or six inches in diameter, and the thickness from that of a strong sheet of paper to 3-16 or ¼ of an inch. They have various cutting edges turned on them. The glass engraver sits in front of his lathe treadling with one foot at a time. He rests his elbow in pads placed on the bench, and holds the glass up to the wheel. When the wheel is revolving, a mixture of emery, petroleum and olive or other oil is fed on to it by the decorator. The reason for this is that copper itself will not cut glass, but simply acts as a medium for the emery mixture. By a simple arrangement, a narrow ribbon of brass is fixed on a long movable arm.

This, when work commences, is brought directly over the wheel, and a small tip of cloth or leather attached touches the wheel. This keeps the flow of emery and oil regular, and at the same time any spots of the mixture that fly off are caught on the brass ribbon. There is no limitation to the work that can be done on one of these lathes, from the very finest of cuts to deep modelled figures, etc. Until recent years, with very few exceptions, all glass engraving was in the white or matt surface as it left the wheel, relieved with polishing and shading.

All patterns are carefully marked out or drawn on the glass, the medium being a mixture of whiting, gum and water. The decorator then selects the wheel to be used, and, having fixed it in the mandrel, proceeds to engrave the design. The leading lines are generally first engraved, then any deep parts are roughed out. The wheels are constantly changed. As soon as the whole of the work possible to be done with one particular wheel is finished, the wheel is replaced by another. During the whole of this process great care is taken with the selection of the emery used. In roughing out, a coarse emery is used, but as each part is approaching the finished state a finer emery is used, so that, when the whole design is completed, the surface of the engraving is finely finished and uniform in appearance. Any bright beads. etc., are polished out with a lead wheel fixed on the spindle, and in cases where leaves, drapery, etc., require shading or partially polishing, a cork or india-rubber wheel is used.

For many years very ambitious pieces were produced in this class of work, and in many cases weeks and months of work were expended on a single piece. Besides figure work, all classes of monograms, crests, animals, and decorative work were produced, but this highly finished decoration is fast dying out, and in a few years' time there will be none of the older craftsmen left.

Bright engraving, known in the trade as rock crystal engraving, is now more generally produced for ordinary use, its bright polished surface being a better proposition as far as cleanliness is concerned. The procedure in rock crystal is similar to that for white or matt engraving, with this exception: it is left in the matt state and afterwards acid polished. In some designs of this class of work, parts of the work are required to be matt. In this case, it is left unfinished before the acid bath. After the polishing process, these parts are finished off by the engraver.

Before going any further, I must call your attention to another style of decorating lathe which is used for this class of work, and generally known as an intaglio lathe. These lathes are more powerful than the copper wheel engraving lathe, and are driven by power. Instead of the copper wheels used by the engraver, the intaglio worker uses a stone, carborundum, or alundum wheel, and may be said to fill the gap between copper wheel engraving and glass-cutting. All work done on the intaglio lathe is eminently suited for acid polishing. Being cut in with a smooth cutting stone, it takes the acid polish quicker than the same work cut on the copper wheel. Of course, very fine work is not done on the stone wheel, as there is a limit to the size of the small wheels. On the other hand, it is simpler and more direct than highly finished and modelled engraving. In many cases the two styles of work are used in conjunction in producing modern rock crystal, parts of the work being done on the stone and part on the copper wheel. Even now the product of the highly skilled engraver in stone and copper is the most artistic decoration produced in the trade. It is very much prized in the United States of America, and the majority of the best class of this work finds a market in that country.

DISCUSSION

The chairman said that if anyone present was in doubt as to any point, Mr. Kny would be very pleased to answer questions.

A speaker asked whether intaglio is not, generally speaking, broader and deeper than rock crystal. Mr. Kny said that some very fine work could be done with intaglio. A practice often adopted was to rough out with a carborundum wheel first and then finish on the power lathe. In the case of a pattern consisting of flowers or fruit, the worker might not finish off on the power lathe, but would cut straight on the engraving lathe before acid polishing. He was speaking of subjects for acid polishing in making these remarks. It was difficult to tell the difference between the two classes of work mentioned, however.

In answer to a question as to whether a vertical or a horizontal wheel is used for flat flutes on tumblers, Mr. Kny said that a vertical wheel is used because the flute is not taken to the top of the glass. The horizontal wheel was used mostly when the flute was taken right to the top, but we did not very often do that in this country.

Mr. James Leather asked if the hollow flutes are done in the same way, and whether hollow flutes are not more difficult to make than flat flutes. Mr. Kny said that hollow flutes are cut in the same way as flat flutes, but he did not think they were more difficult to cut than the flat flute. It required a good workman to flat flute. Answering another question by Mr. Leather, Mr. Kny said that girls marked out the patterns and the cutter follows, the pattern being marked out in red lead.

Asked as to whether the copper engraving lathe is run by power or hand, Mr. Kny said it was mostly worked by foot treadle or hand. At the same time, since girls had been introduced into the engraving shop, and it was not desirable that they should have to work a treadle, power lathes had been introduced. These machines, however, did not permit of the same finish that an engraver would require in the case, for instance, of monogram work, because in doing this the engraver worked his foot on the treadle and his hand unconsciously together in getting the varying speeds required at different parts of the work. The girls did the more routine work such as borders, and the slight change of speed necessary for that purpose is arranged on the back head of the power lathes.

A speaker asked whether it could be taken that acid polishing has practically superseded the wood wheel and putty. Mr. Kny said, practically it has. At first the trade was very conservative about it, however; but it came out cheaper.

A priceless collection of Greek and Roman glassware, dating back to the eighth century before Christ, has been presented to the Wesleyan museum by Dr. Stephen H. Olin of New York, formerly acting president of the university.

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CONTENTS

	Page
Government Specifications for Glass Tableware	79
Recommended Sizes for Milk Bottles	80
Jena Glass	81
American Chemical Society Meeting	82
The Microscopic Identification of Stones in Glass	83
The Decoration of Table and Fancy Glassware	85
Editorial:	
Standardization Is Marching On	88
Sodium Nitrate and Calcium Sulphate as Substitutes for Salt Cake in Plate and Sheet Glass	89
Recent Patents	91
The Glass World and What It Is Doing:	
To Celebrate Prof. Orton's Great Work	94
Atlantic States Shippers' Advisory Board	94
United Glass Bottle Manufacturers' Meeting	94
Society of Glass Technology Meetings	95
Effect of the Japanese Earthquake	95
Experiments with Glasshouse Refractories	95
Peace in the New York Building Industry	95
Verified News of Trade Activities	96
Personal Items	96
Coming Meetings	97
Recent Deaths	97
Inquiries Received	97
Stock Quotations	97
Current Prices of Glass-Making Materials	98
Monthly Summary of United States Foreign Commerce in Glass	98

CLASSIFIED BUYERS' GUIDE, PAGE 18
INDEX TO ADVERTISEMENTS, PAGE 20

Readers of THE GLASS INDUSTRY in the United States and elsewhere are requested to favor the Editor with any information available from time to time concerning developments in their own or other fields which would be of general interest to the industry. Authoritative facts about new glass manufacturing projects, re-organizations, new factory construction, new processes and equipment, raw materials, manufacturing and market conditions, personal items, and other appropriate subjects would be welcomed.

Those experienced in the practical, technical or executive activities of glass manufacturing who are qualified and willing to lend their aid to the upbuilding and progress of the industry by giving from their store of knowledge to others, are invited to submit for publication articles on any subjects relating to glass which would be of interest and value to our readers. The authors of accepted articles of this kind will be compensated at usual rates.

Standardization Is Marching On

Slowly but surely the elimination of waste in industry goes on. The reports of various organizations devoted to the promotion of simplified practices, to the standardization of products and the reduction of types and sizes, show that substantial progress is being made in the right direction in a dozen or more industries.

In the milk bottle industry, for instance, a survey by the Division of Simplified Practice of the Department of Commerce indicated 49 styles and sizes of milk bottles, with tops necessitating 29 sizes of caps. Through intelligent co-operation between manufacturers, distributors and consumers, the styles and sizes of bottles have been reduced to nine, and of caps for bottles to one.

Manufacturers of glass in other forms may well give serious thought to the possibility of lowering the production and distribution costs and improving the quality of their output through a system of universal standardization and to that end may find it profitable to study the industrial significance of standardization, the salient features of which are outlined by the American Engineering Standards Committee as follows:

1. Standardization stabilizes production and employment, since it makes it safe for the manufacturer to accumulate stock during periods of slack orders, which he cannot safely do with an unstandardized product.

2. Reduces selling cost. This is generally overlooked. Possibilities of reduced costs are generally even greater in distribution than in production.

3. It enables buyer and seller to speak the same language, and makes it possible to compel competitive sellers to do likewise.

4. In thus putting tenders on an easily comparable basis, it promotes fairness in competition, both in domestic and in foreign trade.

5. It lowers unit costs to the public by making mass production possible, as has been so strikingly shown in the unification of incandescent lamps and automobiles.

6. By simplifying the carrying of stocks, it makes deliveries quicker and prices lower.

7. It decreases litigation and other factors tending to disorganize industry, the burden of which ultimately falls upon the public.

8. It eliminates indecision both in production and utilization—a prolific cause of inefficiency and waste.

9. By concentrating on fewer lines, it enables more thought and energy to be put into designs, so that they will be more efficient and economical.

10. By bringing out the need of new facts in order to determine what is best, and to secure agreement on moot questions, it acts as a powerful stimulus to research and development—and it is thus in decided contrast to crystallization resulting from fixity of mental attitude.

11. It is one of the principal means of getting the results of research and development into actual use in the industries.

12. It helps to eliminate practices which are merely the result of accident or tradition, and which impede development.

13. By concentration on essentials, and the consequent suppression of confusing elements intended merely for sales effect, it helps to base competition squarely upon efficiency in production and distribution and upon intrinsic merit of product.

14. Standardization is increasingly important for the maintenance and development of foreign trade. There is strategy in nationally recognized "American" specifications.

15. The efficiency of competing countries, increasing through national standardization programs, is liable to transfer competition from foreign markets to our own shores.

Sodium Nitrate and Calcium Sulphate as Substitutes for Salt Cake in Plate and Sheet Glass

Patents covering the use of sodium nitrate and calcium sulphate as substitutes for salt cake in the process of fining lime glass have been granted to Frederick Gelstharp, Tarentum, Pa., and by him assigned to the Pittsburgh Plate Glass Company. The specification of Patent No. 1,488,914, issued on April 1, 1924, to Mr. Gelstharp on a "Method of Making Sheet Glass," gives the following particulars:

The invention relates in a large degree to the means employed for "fining" the glass, the basic batch being preferably similar to that commonly employed.

In carrying out the invention, the patentee has employed the batch set forth below, which will serve to illustrate the principles of the invention although the proportions and constituents may be widely varied as explained more fully later. The formula is as follows:

	Parts
Sand (SiO_2)	1000
Soda ash (sodium carbonate Na_2CO_3)	298
Salt cake (sodium sulphate)	5
Sodium chloride (NaCl)	25
Limestone (calcium carbonate $CaCO_3$)	309
Arsenic (arsenious oxide As_2O_3)	15
Sodium nitrate ($NaNO_3$)	30

The foregoing formula is basically similar to many heretofore employed, one of which, for the purpose of comparison, being the same as that above set forth except that the amount of salt cake in such old formula was 60 parts, the amount of arsenic 5 parts, sodium nitrate was lacking, and 3 parts of charcoal or coal was used. The primary distinctions between the two formulas or batches relates to the ingredients for securing the final ebullition or boiling necessary to fine the glass, such result being accomplished in the old process by the action of the salt cake and the charcoal or coal and arsenic, while in the new process it is primarily accomplished by the arsenic after such arsenic has reacted with the sodium nitrate and taken oxygen therefrom. Following is an approximate statement of the old formula in tabular form:

	Parts
Sand	1000
Soda ash	298
Salt cake	60
Sodium chloride	25
Limestone	309
Arsenic	5
Charcoal	3

With the old process the boiling or ebullition for fining glass was produced by the decomposition of the salt cake, which action was made effective by the action of the charcoal or coal and the reducing flame of the furnace which acted to change a part of the salt cake into a sulphite, arsenate and sulpharsenate being also formed, these compounds together then reacted with some of the remaining undecomposed salt cake producing a boiling effect in the molten glass when its temperature has reached the fining stage. This boiling action in the concluding portion of the operation serves to clear the glass of a large portion of the bubbles held in the glass, such action being known in the art as "fining the glass." This operation, while producing the general effect desired, still resulted in a finished glass containing an undue amount of very fine bubbles or seed rendering a great proportion of the glass unfit for silvering purposes. The inventor believes that this seed, as produced in the old process, was due more or less to what may be termed a deferred decomposition of a small portion of the salt cake which was not decomposed during the main fining operation, such decomposing continuing on a small scale until the conclusion of the heating operation and leaving fine bubbles or seed in the glass as a result. An analysis of the glass made by this old process shows that a small amount of salt cake, about .7 to 1 per cent, always remains in the glass.

It has been the purpose of this improvement to modify the fining operation so that the salt cake, or its equivalent, may be entirely omitted as a fining agent or so reduced in quantity that the minute quantity left in the glass does not act to produce seed after the fining operation, as above set forth in connection with the old process, the salt cake almost disappearing from the finished glass, and the relatively small amount which is employed, being used for a purpose entirely apart from the fining, as hereinafter set forth.

In order to get a glass sufficiently strong or resistant to be used for sheet glass, such as plate, window or optical glass, it is desirable that a relatively high proportion of lime (CaO) as compared to soda (Na_2O) should be used in the batch or melt. This proportion of lime to soda must not be less than 1 to 2 by weight, and it is found advantageous to have the proportions approximate 1 to 1 by weight, those being substantially the proportions given in the two formulas heretofore specified, wherein soda in the 298 parts of soda ash is substantially equal by weight to the lime in the 309 parts of limestone. In such a glass, that is with the proportion of lime to soda 1 to 2 or greater, a scum is formed on the surface of the metal which is very difficult to get rid of and which comprises a high silicate of calcium and sodium. It has been found that this scum may be gotten rid of in this process by the use of a small proportion of salt cake, such salt cake acting in a manner not completely understood, but probably as a catalytic agent causing the scum to entirely disappear.

The salt cake in this process is therefore used as an agent for eliminating the scum characteristic of lime glass, and not as a fining agent as in the old process, the percentage of salt cake used being entirely too small to accomplish this result and not being used with charcoal or other reducing carbon such as is necessary in order to make the salt cake effective as a fining agent.

The primary boiling or fining action with the inventor's preferred process is secured from the sodium nitrate with the arsenic, and by arsenic is meant the white arsenic or arsenious oxide of commerce. Such sodium nitrate supplies oxygen to the arsenic to change it from the lower oxide As_2O_3, to the higher oxide (arsenic oxide As_2O_5), in which form it unites with some of the soda and calcium in the batch, forming sodium arsenate and calcium arsenate and remains for a longer time in the metal. That is, the higher oxide, combined with the soda and calcium, is in a more stable form which resists decomposition until the time is reached when the fining or boiling operation is effective to finally clear the glass. Without the sodium nitrate or some other oxidizing agent, the arsenic has a tendency to vaporize and be lost before the final fining operation in which its action is most beneficial.

The boiling or fining action is therefore accomplished in this process independently of the salt cake, and such salt cake almost disappears from the finished glass which gives an analysis showing sulphur corresponding to only .07% or less of sulphate as opposed to sulphur corresponding to .7% or more of salt cake found in all glass produced by the salt cake fining operation. In other words, only about one-tenth as much sulphate is left in the glass formed by this process (when such process is practiced in its best form) as is the case in ordinary sheet glass formed by the recognized and universally used salt cake method. The inventor finds his process produces a much greater amount of silvering glass than the salt cake method, and of a better color and clearer, due to the absence of the charcoal and sulphur, which is of special importance when the glass is to be used for optical glass, one of the large uses of the glass being for spectacles. In the making of the spectacle blanks the ordinary practice is to cast the glass in sheets like plate glass, which are then cut up into blanks, usually after the plates are ground and polished. The operation of this process is also cheaper since the corrosive effect of the salt cake on the pots is largely done away with and there is a saving due to the lower fusing point of the batch, less fuel being required and

the deterioration in the pots and furnaces incident to the heat being less. These matters as to cost of operation are, however, of small importance as compared to the advantage incident to the superior quality of glass produced.

The preferred process as above outlined might be readily modified to produce substantially the same results by substituting an additional quantity of sodium nitrate to entirely or partially take the place of the soda ash. The amount of sodium nitrate added would correspond to the amount of soda required incident to the reduction in the amount of soda ash or its entire substitution. This modification is not preferred because the sodium nitrate is more expensive than the soda ash, but the results aside from the matter of cost would be substantially the same. The amount of nitrate might, if desired, be considerably reduced below the amount stated in the tabular formula.

It will also be understood that the formula as above given is merely illustrative of the basic portion of the batch. Silica, soda, and lime are, of course, necessary as basic elements but might be gotten into the melt in various forms aside from the sand, soda ash, and limestone. For instance, silica might be provided by some of the feldspars and other silicate minerals, as also a part or all of the soda, and slaked lime or other calcium compounds or mineral silicates used instead of the limestone.

Some substitute may be used for the arsenic, such as antimony, which the oxygen of the sodium nitrate would react with to produce a compound more resistant to decomposition and so available in the late fining stage. This invention contemplates such substitutes as have the action of arsenic as a fining agent when used in a glass batch with a nitrate or other oxidizing agent, to supply oxygen, but the inventor knows of no generic term applicable to such substances, and therefore, refers to them in his definition of the invention in the claims as compounds having the reactions in glass characteristic of arsenic when used with an oxidizing agent, such definition, by his intent, comprehending arsenic itself as well as the substitutes, such as antimony.

Some other nitrate might also be used as a partial or entire substitute for the sodium nitrate, as other nitrates such as potassium nitrate would supply the oxygen necessary to react with the arsenic, and this invention comprehends such other nitrates, although the sodium nitrate is preferable because of its cheapness and the superior quality of glass produced. It is also feasible to use oxidizing agents other than nitrates, such as sodium or barium peroxide or ammonium or potassium persulphate, or chlorate.

The preferred use of a small amount of salt cake has been referred to, but this is not absolutely necessary as the sulphate might be supplied in other ways, as for instance, an impurity in the soda ash or other constituent of the batch, or by using some other sulphur compound such as calcium sulphate or potassium sulphate. Where other sulphates aside from the salt cake are used, however, the ultimate result is the same in that such sulphates are changed into salt cake (sodium sulphate) during the reaction of the molten glass, and serve to eliminate the objectionable scum heretofore referred to. The term "relatively small amount of sulphate as used in the claims is intended to cover an amount only sufficient to eliminate the scum, which amount will range from 5 to 10 parts in the formula heretofore given. Less than 5 pounds will ordinarily not cause the elimination of all the scum, and above 10 pounds the sulphate produces a deleterious effect.

Since the primary function of the nitrate or other oxidizing agent in this process is to oxidize the low arsenic oxide, As_2O_3, and change it to a higher oxide available as a fining agent in the later stages of the melt, it follows that the same general result might be secured by applying the higher oxide to the batch without the oxidizing agent. For instance, arsenic oxide, As_2O_5, might be added to the mix instead of the "white arsenic" As_2O_3, and no oxidizing agent would then be required, or compounds containing the higher oxides might be used, such as sodium arsenate or calcium arsenate. The use of the lower oxide with the oxidizing agent is preferred, however, since the reaction in which the lower oxide is changed to a higher one is beneficial in the glass and the lower oxides are cheaper and more available. The effect of the oxidizing agent which reacts with the oxide is also desirable in disposing of impurities and adding clearness to the glass.

In either case, however, the essential step is the same, viz., the use in the fining operation of an oxide, which reacts in the glass in the manner characteristic of the higher oxide of arsenic, such term including either arsenic oxide As_2O_5 or the higher antimony oxide Sb_2O_5 or other equivalent higher oxide. In the one case, the higher oxide is produced in the glass by the reaction between the lower oxide and the oxidizing agent, while in the other case it is produced before it is added to the glass batch, and in both cases the higher oxide combines with the sodium and calcium in the glass forming sodium arsenate and calcium arsenate, which are very stable and resistant compounds, reacting at a late point in the melting operation to secure the boiling and consequent fining action.

Sodium nitrate had been used before in the manufacture of glass as well as arsenic, but in so far as the inventor is aware they have never been used in the manufacture of a lime glass having the strength necessary in plate and other sheet glasses as a substitute for salt cake, or for fining purposes with a percentage of salt cake so small that the sulphur almost disappears in the finished glass, since plate glass as heretofore made contained a quantity of sodium sulphate many times that in his glass and contained seed in quantities greatly in excess of the seed produced in glass made in accordance with his process.

The specification of Patent No. 1,488,915, issued on April 1, 1924 to Frederick Gelstharp on a "Process and Batch for Making Sheet Glass" is covered, with slight omissions, by the following:

The invention has for its principal objects the provision of an improved batch and process for plate and window glass (1) wherein the use of salt cake for fining the glass is partly or entirely avoided and calcium sulphate (or some material containing such sulphate) or some other cheaper and more readily obtainable sulphate substituted, and (2) wherein a somewhat superior quality of glass is obtained, although having substantially the same composition as that produced where the salt cake is employed.

Salt cake at times becomes very scarce and it therefore becomes desirable to provide a substitute which can be readily obtainable at all times and at a cost below that of the salt cake. It has been found that calcium sulphate ($CaSO_4$) constitutes a substitute for salt cake in securing a fining of the glass and such compound may be introduced in various forms such as in ground gypsum or anhydrite or a calcined gypsum (plaster of Paris) or precipitated sulphate of calcium. To indicate the character of the substitution of the gypsum for the salt cake, a comparison of a characteristic batch heretofore commonly used employing salt cake, and the same batch with the calcium sulphate substituted for the salt cake will be made. The following is an approximate statement of the old formula as employed in the manufacture of plate glass:

	Parts
Sand (SiO_2)	1000
Soda ash (sodium carbonate Na_2CO_3)	284
Salt cake (sodium sulphate)	60
	(95° Na_2SO_4)
Limestone (calcium carbonate $CaCO_3$)	309
Common salt (sodium chloride NaCl)	25
Coal	3
Arsenic (arsenious oxide As_2O_3)	5

With the foregoing batch the boiling or ebullition for fining the glass is produced by the decomposition of the salt cake which action is made effective by the action of the charcoal or coal, and the reducing flame of the furnace.

It has been found that this same fining action is secured with corresponding reactions, when calcium sulphate or a material containing it is substituted for the salt cake. In such case the calcium sulphate reacts with some of the soda ash to form sodium sulphate, such action occurring at a stage in the melting operation preceding the fining. The sodium sulphate thus formed later reacts in the fining operation. In case gypsum is used in place of the salt cake the new batch would be as follows:

	Parts
Sand	1000
Soda ash	317
Gypsum	69
	(78.6% $CaSO_4$)
Limestone	268
Common salt	25
Coal	3
Arsenic	5

Gypsum varies somewhat in composition, a typical analysis of such material as employed in the foregoing formula being as follows:

	Per Cent
Calcium sulphate	78.60
Combined water	20.00
Calcium carbonate	.20
Magnesium carbonate	.25
Iron and aluminum oxide	.30
Silica and insoluble	.65
	100.00

In shifting from the old salt cake batch to the new batch as above stated, the weights of the material which are changed are preferably adjusted in accordance with chemical equivalent ratios so that the resulting glass composition as produced by the new batch is substantially the same as that produced by the old batch.

As indicated before, the calcium sulphate may be introduced in different compounds, and if desired a part only of the salt cake may be replaced by the calcium sulphate. It is also possible that other sulphates aside from calcium sulphate may be substituted in part or in whole for the sodium sulphate of the salt cake, such as the sulphates of barium, magnesium or potassium, in which case, of course, a corresponding readjustment in the other ingredients of the batch may be necessary.

The glass produced by both the old and new formulas heretofore recited are what may be termed lime glass, such glass necessarily containing a relatively high amount of lime (CaO) as compared with the soda (Na_2O) in order to be sufficiently strong to be used for sheet glass. This proportion of lime to soda should not be less than 1 to 2 by weight, and it is preferable to have the proportions approximately 1 to 1 by weight. While gypsum and other materials containing calcium sulphate have been used as ingredients of glass batches, in so far as the inventor is aware they have never been used to produce a lime glass having the strength necessary for plate and window glass and which reacts to provide sodium sulphate that in turn reacts at a later stage in the operation to produce a fining of the glass.

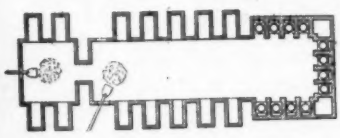
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

Glass-Melting Tank. U. S. 1,486,992. Mar. 18, 1924. Harry G. Slingluff, of Mount Vernon, Ohio, assignor to Pittsburgh Plate Glass Company.

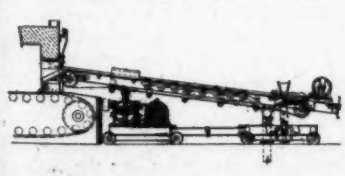
Hitherto difficulty has been experienced in increasing the size and capacity of a melting tank beyond certain limits more or less recognized among manufacturers due to the difficulty in properly melting and fining the larger quantity of glass required corresponding to the increase in size. This



invention contemplates the maintenance of the dimensions of the main melting and fining tank at approximately the proportions corresponding to the accepted practice, and supplementing the capacity of the tank, as thus constructed, by means of a supplemental melting unit, which discharges molten glass into the melting end of the main tank. The capacity of the tank is increased since the speed of reducing the batch or cullet from a solid to a liquid is largely increased, since the batch when once reduced to molten form is readily fined in the fining section of the tank without any increase in the capacity of such fining section. The addition of the supplemental tank, it is claimed, gives an increase in capacity out of all proportion to the increased cost of the addition. The invention is also not limited to a single supplemental melting unit, but still other units may be added.

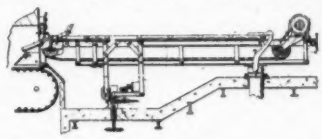
Conveying Mechanism. U. S. 1,487,000. Mar. 18, 1924. Percy Q. Williams, of Cincinnati, Ohio.

The inventor claims combination of a lehr, a lehr conveyor, an endless belt conveyor, a frame on which the latter is mounted, said frame mounted to swing about a vertical axis remote from the lehr and thereby swing one end of the belt conveyor transversely of the lehr, a chute by which articles are guided from the belt conveyor to the lehr, said chute carried with said frame, an arc-shaped inclined wall extending across the end of the lehr beneath said chute and in position to retain articles in a heap as they are discharged from the chute and stacked up on the lehr conveyor, and means to convey articles to the belt conveyor.



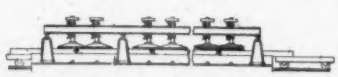
Apparatus for Receiving Glassware. U. S. 1,487,001. Mar. 18, 1924. Percy Q. Williams, of Cincinnati, Ohio.

This invention relates to apparatus for receiving glass ware such as bottles, jars, etc., and transferring them to a lehr and placing them in position on the lehr conveyor. The inventor claims in a device of the class described the combination with a pivotally mounted frame and an endless belt movable upon the frame, of a mechanism to oscillate the frame about its pivotal mounting comprising a platform mounted on the frame, a bar over which the platform may move, an arcuate rack mounted on the bar, a motor mounted on the platform, a shaft mounted on the platform having a driving connection with the motor, a gear carried by the shaft engaging the arcuate rack, and means to reverse the motor at the limits of oscillation of the frame; the frame being pivotally mounted at one end on the tube and having its other end disposed without and adjacent to the lehr, an endless belt mounted on the frame and a chute adapted to direct articles into the lehr.



Apparatus for Grinding or Polishing Plate Glass. Re. 15,788. March 4, 1924. Frederic B. Waldron, of Prescot, England, assignor to Pilkington Brothers, Ltd., of St. Helens, England.

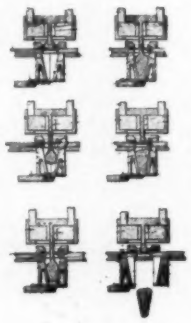
The inventor claims apparatus for grinding or polishing plate glass consisting of a series of rectangular tables in contact each with its neighbors forming a continuous support for the plates of glass and slidingly supported on fixed guides, a framework above the series of tables, a series of sets of runners on vertical shafts, bearings for the shafts attached to the framework, means for moving the series of tables continuously from one end to the other of the series of sets of runners, means for removing a table from the moving series of tables after it has left the last set of runners, and means for adding a table to the moving series of tables before the first set of runners, the sets of runners being so spaced apart



as to permit of the effective washing away of the abrasive between any two sets using different grades.

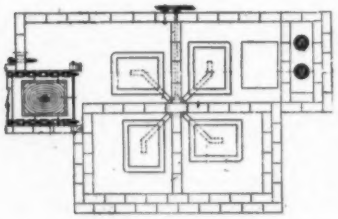
Method of and Apparatus for Feeding Molten Glass Into Molds. U. S. 1,484,907. Feb. 26, 1924. Alexander L. Schram of Hillsboro, Ill., assignor to Schram Glass Manufacturing Company of St. Louis, Mo.

The invention comprises a method of separating molten glass into mold charges, which comprises flowing a stream of glass through an outlet in a container, enlarging the end of the stream below the outlet at intervals, utilizing the enlarged end of the stream as a moving plastic support for the on-coming stream of glass and a portion of the gathered mass, bodily arresting the downward movement of the accumulated mass until a sufficient quantity to make the desired article has been accumulated, simultaneously severing the stream above the accumulated mass and releasing the accumulated mass on its bottom, and thereafter releasing the accumulated mass on its sides.



Rotating Glass-Molding Device. U. S. 1,489,729. April 8, 1924. Frank Aucremanne, of Clarksburg, W. Va.

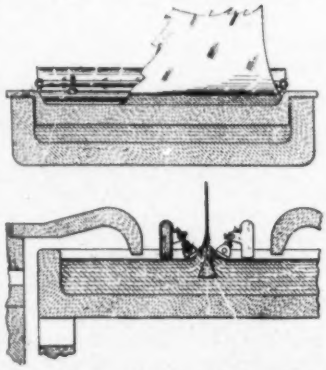
This invention comprehends improvements in the means and methods employed for forming convex glass and other shapes, from sheet glass. The main object of this invention is the production of a four-part heating furnace, a centrally-located, rotating, mold-carrying device upon the arms of which are attached molds, suitable for molding convex glass, or other shapes; and upon which molds, heated sheet glass may be placed, and, while rotating from one part of the furnace to the other, the glass settles or sinks by gravitation into the mold while passing through each of the four parts of the furnace, without the use of pressure; the sheets of glass are then sufficiently cool to be transferred upon the conveyor and passed through an annealing oven, for annealing purposes.



Drawing Sheet Glass. U. S. 1,489,876. April 8, 1924. James Whittemore, of Detroit, Mich. Assignor to the Libbey-Owens Sheet Glass Company, Toledo, O.

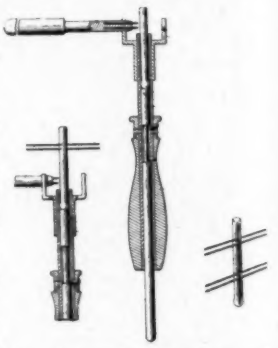
When a sheet of glass is drawn from a mass of molten glass, for some reason there are produced very shallow inequalities or waves on the surface, which are very undesirable.

It is inventor's opinion that these waves are largely produced by variations in the surface tension at different points in the sheet width, and that these waves are due to the slightly different heat conditions in the glass at the base of the meniscus. In order to overcome some or all of these waves, the glass along the lines of the base of the meniscus is heated and thus equalizes the surface tension at all points. This adding of the heat to the surface may, in some cases, require that the middle or mass of glass which goes into the sheet, shall be slightly lowered in temperature, and, in such cases a cooling bar beneath the middle of the meniscus is employed.



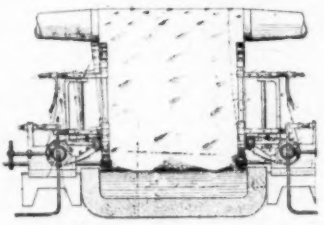
Device for Treating Glass. U. S. 1,487,288. March 18, 1924. Sigurd Thronsen, of Chicago, Ill. Assignor to Western Electric Company, Inc., of New York, N. Y.

This invention relates to a device adapted for the treatment of glass or the like and has particular reference to one for inserting wires into rods of such material. In the operation of the device, the plunger is moved to its lowermost position and a glass rod is placed in the upper end of the holder. The operator places the proper wires into the tool and subjects the glass at the desired part thereof to the heat of a flame so as to soften it. At the proper moment, he places the tool on the bracket support and forces the wires into the glass as far as they will go. The plunger is then moved upwardly a definite distance determined by the distance between the shoulders shown on the plunger, whereupon the glass rod is positioned anew with respect to the bracket support. The operation of inserting wires is again repeated for the other side of the rod, as above described.



Drawing Continuous Sheet Glass. U. S. 1,489,852. Apr. 8, 1924. Clifford A. Rowley, of Toledo, O. Assignor to the Libbey-Owens Sheet Company of Toledo, O.

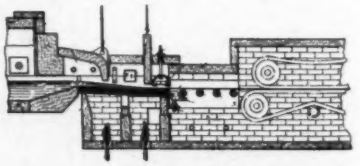
This invention is claimed to be an improvement in the art of drawing sheet glass, and relates to a method and apparatus for maintaining the width of the sheet, and stretching the sheet laterally, while the sheet is still in process of formation and in a plastic condition.



The inventor claims in combination with a source of molten glass, and means for continuously drawing a sheet of glass therefrom, a continuous series of independent gripping members moving in pairs at the opposite sides of each edge of the sheet, a water cooled guide for each series of grippers, a supporting frame on which each pair of guides is pivoted, spring means between the frame and guides for holding the grippers yieldably against the sheet, a supporting base to which the frame is pivoted, and an adjustable connection between the frame and base for varying the inclination of the guides with respect to the line travel of the sheet.

Drawing Continuous Sheet Glass. U. S. 1,489,823. April 8, 1924. Joseph P. Crowley, of Toledo, O. Assignor to the Libbey-Owens Sheet Glass Co. of Toledo, O.

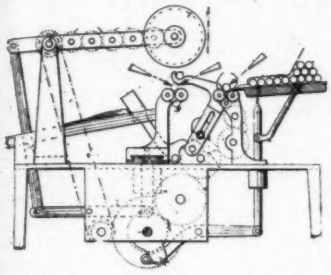
An improvement in the process of drawing sheet glass horizontally from a source of molten glass. The difficulties encountered with all such systems, are largely due to the fact that the excess of molten glass overflows down the edge of the drawing lip, eventually devitrifying at this point, and forming accumulations of "dog-metal," which cause lines and other defects in the sheet.



In this present improved system, the molten glass flows out from the source onto a slab of graphite or similar material which will not adhere to or injure the hot glass, and the glass is cooled and stretched or attenuated into sheet form while still remaining on the slab, so that before leaving the surface of the slab it has assumed a practically solid sheet form, although still semi-plastic, and capable of being stretched through a combined drawing and flattening apparatus.

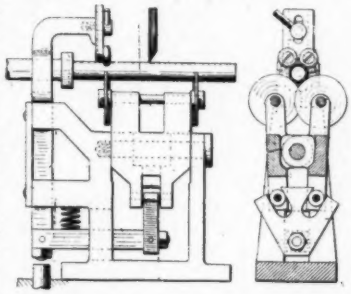
Bottle or Vial Making Machine. U. S. 1,489,836. April 8, 1924. David B. King of Millville, N. J. Assignor by Mesne Assignments to Kimble Glass Company, Vineland, N. J.

Among the inventor's claims in a machine for making glass bottles or vials from tubes is the combination of two sets of rollers adapted to support blanks and arranged in pairs spaced apart, an arm having two sets of fingers of which one delivers blanks from one set of rolls to the other set of rollers and of which the other fingers deliver the finished product from the second set of rollers, a slot-and-pin support for the arm, and crank means to operate the arm, substantially as described.



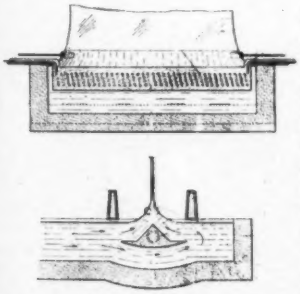
Machine for Necking Vials or Bottles. U. S. 1,489,837. April 8, 1924. David B. King, of Millville, N. J. Assignor by Mesne Assignments to Kimble Glass Company, Vineland, N. J.

Vials or bottles are made from pieces of glass tubing which is supposed to be of substantially the same diameter, but in fact glass tubing rated as of the same diameter varies in size. The mechanism which forms the necks of such vials or bottles operates upon the end of a tube while the same is in rotation so that it is important that the tube be properly centered in respect to that mechanism because otherwise the necks both inside and outside will not be uniform. The principal object of this invention is to provide mechanism for automatically presenting the rotating tubes properly to or co-axially with the corkage forming mechanism, even though the tubes vary in diameter, while nominally of the same size.



Drawing Continuous Sheet Glass. U. S. 1,489,875. April 8, 1924. James Whittemore, of Detroit, Mich. Assignor to the Libbey-Owens Sheet Glass Company, Toledo, O.

An object of this invention is to provide a heater within the molten mass for the glass which goes to form the core or interior of the sheet, so that the pulling stress on this portion of the sheet will be relieved and the outer, cooler surface portions, forming a casing for the sheet, will be stretched taut thus making smoother and flatter surfaces. A further object is to provide a heated partition within the molten glass, beneath the line of generation of the sheet, which will compel equal flows of molten glass into the sheet from both sides thereof. The fact that this partition member is heated will avoid the formation of dog-metal or devitrified glass, which always tends to accumulate around any cool object which is placed within the molten mass. The heated partition will heat the glass in the vicinity thereof and allow a free and unimpeded flow thereabout.



Composition for Producing Glass. U. S. 1,489,026. April 1, 1924. Alexander L. Duval d'Adrian, of Washington, Pa.

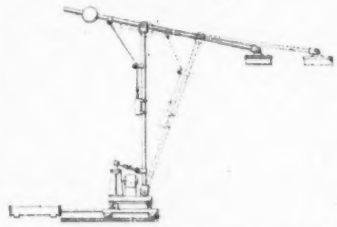
The inventor states that he has discovered that by the use of natural double silicates, he can obtain a glass of a higher calcium content, than can be obtained by any other method now known, and that the glass in which these double silicates are present has a relativeiy low melting point. The natural double silicates are combined with the usual glass mixture or batch.

The following is an illustration of a composition for producing glass in accordance with the invention:

	Lbs.
Sand	1000
Soda ash	365
Limestone	205
Pectolite or other natural double silicates of sodium and calcium	50–500

Apparatus for Flattening Glass. U. S. 1,490,521. Apr. 15, 1924. Laurence E. Stewart, of Bradford, Pa.

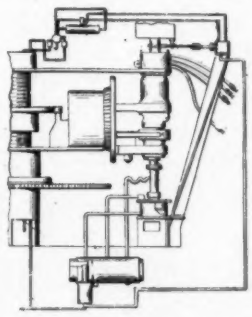
One object of this invention is to provide simple and efficient mechanical appliances which may be readily controlled and operated by unskilled labor to flatten and smooth a glass shawl, and reduce the cost of shawl flattening operations to a minimum.



The inventor's claims cover apparatus of the character described, the combination with a reciprocatory support, of an oscillatory mast mounted on said support, a beam pivotally connected with said mast, a flattening and smoothing block pivotally connected with said beam, means whereby said beam may be moved on its pivotal connection with the mast, a shaft carried by said support and provided with a crank, a pitman connecting said crank with the oscillatory mast, a motor mounted on said support, gearing between said motor and shaft, a post supported independently of said support, a gear wheel mounted on said support, a pitman connecting said gear wheel with said post, and a gear carried by said shaft and meshing with said gear wheel.

Molten-Glass Charge Supply. U. S. 1,490,182. Apr. 15, 1924. Frank O'Neill, of Toledo, Ohio.

This invention relates to gathering or charge supplying, especially of molten glass to glassware forming apparatus.



The inventor's claims cover means providing a downwardly continuously flowing laterally peripherally exposed stream of molten glass, a normally open shear, means for operating the shear for severing the stream of glass into slugs, a guide in the line of the stream, therebelow and approximating in cross-sectional area the cross-sectional area of the stream, for receiving the slugs, an annular series of molds successively movable into registering position with the guide, suction means co-acting through a guide registering mold, and control means for the shear and suction means for at once accelerating the slug as it is severed for travel through the guide into the mold therebelow.

REMOVING YELLOW COLOR IN GLASS

A process is described in French Patent No. 547,091 for neutralizing or modifying the yellowish tinge which is communicated to glass by oxide of iron in the case of boro-silicate glasses. In order to correct this greenish yellow color which is so common in these glasses it is proposed to introduce oxide of neodymium in the proportion of from half to one per cent. When a greater proportion of the oxide is added to the glass batch, a rose-colored product is obtained. This process does not apply to true glasses as much as it does to alkaline boro-silicates.

The Glass World and What It Is Doing

News of the Industry

To Celebrate Prof. Orton's Great Work

The American Ceramic Society, through its general secretary, Ross C. Purdy, has issued a letter to various ceramic trade association calling attention to the 30th anniversary of the founding of the world's first collegiate department of ceramic engineering in 1895, at the Ohio State University.

The establishing there of the Ceramic Department gave the first opportunity for training in those engineering and science branches which are most essential to development of the ceramic industry. Following the establishment of the Department at this University, opportunity for collegiate training was provided in England, Germany, Austria, France, Belgium and Japan, and under the sponsorship of departments of science, similar opportunities were given in Australia and other British colonies where the ceramic industries would warrant. In America, collegiate departments have been established at Alfred University, New York; Rutgers College, New Jersey; University of Illinois; Iowa State College, University of North Dakota; University of Washington, Colorado School of Mines, Georgia School of Technology, Pennsylvania State College and the University of Saskatchewan, Canada. Ceramic departments for research were established in the federal Bureau of Standards and Bureau of Mines and at Mellon Institute. Several schools have departments especially devoted to the production of art pottery, where the technology of ceramic mixing and making forms a part of the curriculum.

These opportunities for training the youth in the essential fundamentals have meant more to the ceramic industries than any of us have really thought, wrote Dr. Purdy. A measure of the importance of these centers of training is the fact that requests for trained men exceed the supply nearly ten to one.

Believing that the 30th anniversary of the beginning of this application of science and technology to ceramics by means of collegiate training should not be passed unnoticed, but should be celebrated in appropriate form while the father of this movement is still alive and able to enjoy the expressions of appreciations which surely are due him, the Board of Trustees of the American Ceramic Society decided to hold its 1925 annual convention at Ohio State University, so as to give opportunity for ceramists generally to join with the University in this celebration.

The ceramic industries owe more to Prof. Edward Orton, Jr. on account of the establishing of this first collegiate department of ceramic engineering than can possibly be repaid to him, and it would be very little in comparison to the debt owed to join with the University in celebrating this anniversary and giving due honor to Prof. Orton.

The week of February 16, 1925 has been designated as the time for this celebration. Monday will be given over entirely to exercises conducted by the University. The American Ceramic Society will hold its industrial Division meetings on Tuesday and Wednesday. If there should be other groups who desire to meet during this same week in Columbus so that their members may join in this celebration, satisfactory arrangements will be made. It is hoped that all will keep that week in February free from conflicting meetings.

Atlantic States Shippers' Advisory Board

A committee has been formed under the chairmanship of J. T. Hendricks, director of traffic, Glass Container Association, to co-operate with the Atlantic States Shippers' Advisory Board, an organization which is intended to form a common meeting ground between shippers and railroads for the better understanding of transportation questions, to adjust informally car difficulties which may arise between carrier and shipper, and to give the shipping public a direct voice in the activities of the Car Service Division on all matters of mutual concern. L. L. Stokes, Bridgeton, N. J., traffic representative of the Illinois Glass Company, is vice-chairman. Others on the committee include E. S. Thorpe of Whitall-Tatum Company, W. B. Swindell, Jr. of Swindell Brothers, A. W. Stebbings of Thatcher Manufacturing Company, J. D. Dilworth of Salem Glass Company, J. M. Gayner of Gayner Glass Works, A. F. Reed of F. E. Reed Glass Company, A. C. Yetter of Binghamton Glass Company, J. E. Farrell of Acme Glass Company, W. P. White of Anchor Cap & Closure Corporation and W. R. Smallwood of Crown Cork & Seal Company.

United Glass Bottle Manufacturers Meeting

The Eleventh Ordinary General Meeting of the United Glass Bottle Manufacturers, Limited, was held at the offices of the company, 40-43 Norfolk street, W. C. London, England. Sir Ernest F. Oldham (the chairman) presided.

This company comprises the following concerns: Cannington, Shaw & Company, Ltd., Nuttall & Company (St. Helen's), Ltd., Robert Candlish & Sons, Ltd., Alfred Alexander & Company, Ltd., E. Breffit & Company, Ltd. and the United Glass Bottle Manufacturers (Charlton), Ltd. Its production varies from a bottle under half-ounce capacity to a 16-gallon carboy. Thousands of different types are made. Its bottle factories are the largest in Europe, with a manufacturing capacity of 250,000,000 bottles per annum.

From an account of the meeting in the *Times* (London) of April 4th, the following abstracts have been made.

The sum of £48,930 5s. 7d. has been written off for depreciation for the year 1923. The capital reserve has been increased from £64,855 5s. 9d. to £106,795 15s. 8d.

The investments at cost held by the trustees for the debenture holders amount to £31,374 9s. 2d., as compared with £6,199 9s. 2d. at the end of the preceding year, and this increase is largely accounted for by the fact that on December 31 last the company paid to the trustees' account the first instalment of sinking fund, amounting to £24,000.

The board have now been able to agree finally the various outstanding liabilities in respect of which a contingency fund of £90,000 was reserved in preceding years. That has enabled the transfer of the amount of £15,200 to capital reserve, and to transfer to profit and loss account the sum of £28,089 18s. 8d.

The net profit for the year £43,388 9s. 4d. only shows a slight improvement on the profits for the preceding year, but during the latter part of the year the results of the company showed satisfactory improvement, which has been fully maintained.

To the balance of profit and loss brought forward from last year (£54,444 18s. 1d.) there has been added the amount transferred from contingency account of £28,089 18s. 8d., £44,356 6s. in respect of reserves for income tax and excess profits duty not now required, and after adding the net profit for the year ended December 31 last of £43,388 9s. 4d., and allowing for the £40,000 transferred to general reserve, there remains a net balance of £130,279 12s. 1d.

The chairman thought he was justified in saying that the company is in a very sound financial position. During the past year, after making substantial depreciations and proper reserves in respect of stocks (which, as pointed out, appear in the accounts at a low figure) and paying debenture interest, the company made enough profit to cover the year's interest on the preference shares, although, as stated in the report and for reasons which will be given more in detail later, the board found it advisable to defer payment for the present.

Calculations will show that the liquid assets exceed the liabilities by approximately £190,000, and, as before mentioned, the capital reserve amounts to £106,795 15s. 8d., the general

reserve to £40,000. Except for the item of taxation, there are no outstanding liabilities other than ordinary trade liabilities.

The company's business continues to expand, particularly in the export trade, but the greater the expansion the greater the amount of working capital required. That has been the drawback from which the company has suffered during the last two years, and not from the fact that it was not working at a profit. As a matter of fact, the company has since its formation in 1912 made profits every year except in 1921, when, as is well known, very few industrial companies made profits. If conditions continue to improve, the resumption of the payment of the preference dividends should not be long deferred.

Appreciation of the board for the services rendered to the company by the staff during the past year was expressed, special mention being made of Mr. Moorshead, general manager and chief engineer, a gentleman of world-wide repute in the glass trade, Mr. Glew, the secretary and Mr. Judd, chief of the sales organization.

The Society of Glass Technology

The annual general meeting of the Society of Glass Technology was held in Sheffield on April 16. The seventh annual report of the Council was presented. The number of members on the roll, December 31, 1923, was 615; of whom one was honorary, 118 collective, and 496 ordinary members. Members registered from the British Isles number 425; from the United States, 109; Japan, 21; France, 15; Canada, 7. The remaining 38 members hail from 12 different countries. The financial condition of the Society was reported to be satisfactory.

The Sixth Annual Dinner will be held at the Hotel Cecil, London, on May 27.

Stourbridge Meeting

At the meeting held in Stourbridge on March 19 the President, Prof. W. E. S. Turner, presided.

The first paper on the agenda dealt with the "Properties of Lead-Containing Glasses." Prof. Turner, who communicated this paper, described the special properties of the alkali-lead oxide glasses, with particular reference to their thermal expansion, chemical durability and electrical properties.

Mr. J. Northwood followed with a paper entitled "The Art of British Glass Decorators—The Duplication of the Portland Vase." The Portland Vase, he said, was regarded as the greatest achievement of the ancient glass makers. Up to the time when Josiah Wedgwood borrowed it from the Duke of Portland for the purpose of imitating it in his jasper ware, it was thought to be stone or earthenware, owing to its dull appearance. The vase is composed of two glasses, the inner body or groundwork being of a very dark blue transparent glass, and the outer casing of white opal glass out of which the ornament and figures are sculptured. This decoration stands up in relief from the blue ground.

Effect of the Japanese Earthquake

Of approximately 46,000 factories in Japan proper, only 4,436 were located in the earthquake-affected area, according to a summary of the catastrophe's effects by Jefferson Caffery, U. S. Charge d'Affaires ad interim in Tokio.

More than one-half of all the electric light bulbs produced in Japan were manufactured in the district affected by the earthquake. The damage to this industry is estimated at approximately 15 per cent of the output in the affected area, or 8 per cent of total production.

Practically all of the factories devoted to the manufacture of glassware in Tokio Prefecture were completely destroyed while those in Kanagawa Prefecture escaped with slight damage. It is estimated that the entire industry has been affected by about 12 per cent.

The evidence contained in Mr. Caffery's report, while neither altogether complete nor conclusive, indicates a loss of about one-third of the industrial undertakings in the Prefectures of Tokio and Kanagawa and that the total loss of productive capacity of the entire country will amount to about 8 per cent.

Experiments with Glasshouse Refractories

The Bureau of Standards has been carrying out some experiments on the composition and method of making the "cut offs" used in controlling the flow of glass to automatic bottle machines. Recently a complete set of these "cut-offs" consisting of 25 shapes has been cast. For this work a mixture of clay and grog that has been found to be resistant to glass attack and spalling was used. Four additional shapes of a second set, the body composition of which is somewhat different as to grog sizing as well as grog-feldspar content, have also been cast. The ten shapes reported as cast during February have been burned. A plaster mold has been completed for casting "flow-spouts" which are used in connection with the "cut offs," the proper specific gravity for the slip in this process has been determined, and six of these shapes have been cast. The same bodies used in the manufacture of the "cut offs" are being used in making up the "flow spouts."

This investigation is being carried out in co-operation with the Hazel-Atlas Glass Company and the shapes which are made in the Bureau laboratories will be subjected to actual service in their plants.

Peace in New York Building Industry

One hundred per cent peace in the New York building construction industry has never been so close to reality as it in this spring, writes Allen E. Beals in the current Dow Service Daily Building Reports.

"This means," said John Halkett, President of the New York Building Trades Council, "that eighty-seven trades identified with the erection, equipment and finishing of all kinds of building erection, totalling 145,000 skilled artisans, in the jurisdiction of this council alone, are satisfactorily employed on a wage agreement that does not expire until December 31, 1925.

"In looking back over the last twenty-five years neither my associates nor I can remember a springtime building season start off with a record for harmony like this one, for at the present time there is not a single recorded disagreement or dispute disturbing the peaceful progress of building construction industry in Greater New York."

Standard Plate Glass Affairs

Widely published newspaper statements to the effect that the Standard Plate Glass Corporation had increased its capital from $16,000,000 to $28,000,000 were denied by W. H. Turner, vice-president and treasurer, who on April 18 stated that the capitalization of the corporation is as follows:

	Par	Authorized	Outstanding
Prior preference 7% cumulative preferred stock	$100	$2,000,000	$2,000,000
7% cumulative preferred stock	100	6,000,000	4,125,000
Common stock	None	200,000 Shares	200,000 Shares

The Corporation recently announced the completion of negotiations whereby the Watson Paint and Glass Company of Pittsburgh, together with important affiliated interests, will be merged into the Standard corporation. The transaction is said to involve about $1,000,000. The Watson Paint and Glass Company is a large manufacturer of paints and varnishes, and kindred products, and was established in 1902. In addition to manufacture of paints, varnishes, etc., the Watson Company distributes plate glass and other kinds of glass through its nine distributing warehouses.

Hearing on Materials-Handling Formulas

A public hearing with users of materials-handling equipment will be held during the Spring Meeting of the A. S. M. E. by the special committee of the Materials Handling Division, on the preparation of Formulas for Computing Economies of Labor-Saving Equipment. Any user of materials-handling equipment is invited to attend the meeting in Cleveland, May 28.

Verified News of Trade Activities

The Jeannette Glass Company, Jeannette, Pa., is erecting an addition to its plant at an estimated cost of $50,000 to be used as a warehouse and packing wareroom.

The H. E. Caldabaugh Paint & Glass Company, Wheeling, W. Va., has been incorporated with a capital of $50,000, by H. E. Caldabaugh, B. S. Honecker and others.

The window glass plant of the **Connolly Glass Company,** Caney, Kans., was completely destroyed by a fire of unknown origin on April 6, at an estimated loss of about $250,000.

Clinton Auto Glass Works, 178 Badger Avenue, Newark, N. J., has been organized to make glass specialties. Louis Karp, 394 Avon Avenue, Newark, is head of the company.

The Hubert Art Glass Company, Bridgeport, Conn., has been incorporated with a capital of $50,000. The incorporators are Joseph Hubert, Henry Grunstein and John L. Carpenter.

The Sterling Glass Company has been incorporated at Erie, Pa., with a capital of $25,000, by J. J. Finucane, Erie; R. A. Sansenbacher, Cleveland, O., and T. W. Helwick, Erie, Pa.

The Chicago office of the **Quigley Furnace Specialties Company,** manufacturers of Hytempite refractory cement and Insulbrix, has been moved to larger quarters at 9 South Clinton Street.

The Ideal Mirror and Glass Company, New York, N. Y., has been incorporated with a capital of $25,000, by A. T. Carson, W. E. Godfrey, and A. S. Marx. Godfrey & Marx, 198 Broadway are attorneys for the company.

Amsler-Morton Company, Inc., Fulton Building, Pittsburgh, Pa., have issued an 8-page bulletin giving particulars of the Amco Liquid Fuel Burning Systems. The equipment comprising the system is described briefly and many of the parts are illustrated. Copies of the bulletin may be obtained upon request.

The Interstate Commerce Commission has announced that they have reopened for further hearing the interchangeable mileage ticket investigation, as petitioned for by the National Council of Traveling Salesmen's Association, which claims to have additional evidence as to the constitutionality of placing interchangeable mileage tickets on sale.

The Gill Glass Company, Philadephia, Pa., has let contracts for several improvements to its factory including a one-story addition to be used for general manufacturing purposes and estimated to cost $30,000, an addition to the carton department to cost $35,000, and a contract for a new furnace to the B. F. Morton Company, Blawnox, Pa.

The **Owens Bottle Company** factory at Fairmont, W. Va., was damaged to the extent of several hundred thousands of dollars on March 29, when a cloudburst caused a small stream which runs through the works to overflow and flood the plant. Five tanks were seriously damaged, necessitating the closing down of the works, part of which will require several weeks for repairs.

At the Engineers' Open House held on April 11 and 12 at the **University of Washington,** Seattle, Washington, an exhibition was made of products of the State including: glass tumblers, brick and tile, pottery, spraying and firing of terra cotta, Eastern Washington kaolin, super-refractories and enameled metals. Ceramic engineering students took the first prize. Several thousand people visited the exhibition.

The twenty-first annual statement of the **Harbison-Walker Refractories Company,** Pittsburgh, Pa., covering the year 1923, shows earnings of $3,651,582 after charging off $707,125 for depreciation and depletion of plants, equipment, mining properties, etc. Dividends of $1,683,484, were paid on preferred and common stock, leaving a surplus profit for the year of $1,968,097, and making a total surplus on December 31, 1923, of $7,715,126.

Fires were lighted early in April under the large furnace at the recently organized **Pittsburgh Sheet Glass Company's** plant at Washington, Pa. This industry occupies the old plant of the Pittsburgh Window Glass Company on the Connecting Railway at West Wylie Avenue. The original buildings have been greatly altered and new equipment for manufacturing by the cylinder process has been installed by the Simplex Engineering Company. The furnace now being put into operation has a capacity of approximately 1,000 tons.

The Niles, O., plant of the **National Lamp Works** of the **General Electric Company** has resumed operations after extensive plant improvements have been made. Danner tube drawing machines and a Westlake bulb blowing machine have been put into operation. Z. C. Kline, from the Rhode Island bulb works of the General Electric Company which was recently sold to the Corning Glass Works, is now manager of the Niles plant. O. H. Ide, is assistant manager; A. H. Burchard, master mechanic; M. A. Smith, mechanical engineer; H. L. Frew, chemical engineer; D. A. Dewey, consulting engineer of Cleveland; Carl Hallquist, Ralph Hallquist and William Duffeil, shift foremen on the bulb blowing machines and Judd Husted, Daniel McNamara and Louis Vidoni, shift foremen in charge of tube machines.

The stockholders of the **Ohio Glass Products Company,** a "community plan" organization comprising principally numerous citizens of Massillon, O., who recently subscribed sufficient funds to carry through the project of taking over and operating the idle plant of the Rhodes Bottle & Glass Company, located in that city, held a meeting on March 24 and elected directors as follows: Harry S. Potter, W. E. N. Hemperly, C. E. Stuart, C. W. Stuart, C. L. Baatz, Lee F. Graybill, Andrew Reese, H. C. Daubenspeck, C. P. L. McLain, C. E. Swanson, Arthur T. Ellis, E. M. Brickel, F. F. Taggart, F. W. Arnold and S. M. Baltzly.

Harry S. Potter, former sales manager of the Ball Brothers Glass Company with whom he was associated for many years, was elected president; C. W. Stuart was made vice-president. C. E. Stuart was chosen chairman of the board. W. E. N. Hemperly was named temporary secretary and treasurer. Two Winder-Daubenspeck wide mouth bottle blowing machines are being installed and other improvements being made.

Personal

Harry M. McEwen, who has been connected with the Lippincott Glass Company, Alexandria, Ind., for the past sixteen years in the capacity of general manager and assistant to the president, has severed his connections with that company.

Harvey Lee, formerly in charge of the Cincinnati district for Wilson-Maeulen Company, New York, manufacturers of pyrometer equipment, has been transferred to Pittsburgh and will have an office in the Fulton Building. Mr. Lee has had long experience in temperature measuring equipment and the Company's customers in the Pittsburgh district will continue to have prompt and efficient co-operation, as in the past. Mr. Lee's vacancy in the Cincinnati territory is filled by F. G. Hunt, 403 Upland Place.

W. P. Parsons, formerly connected with the Corning Glass Works in a consulting and advisory capacity in the manufacturing and development end of the business, was recently appointed superintendent of the National Glass & Lens Company, Lancaster, O. Mr. Parsons had been with the Corning Glass Works for twelve years, part of the time in charge of the mold and machine department while the development of the molds for pyrex ware was going on. He has also had considerable experience in the manufacture of colored and technical glass and will therefore feel at home in his new environment, the National Glass & Lens Company's line including many kinds of high grade lenses and other products.

M. G. Babcock on April 16 entered the employ of the Pittsburgh Plate Glass Company as assistant to Manager A. H. Chandler, of their Refractories Department. This addition to the Refractories sales' force was necessitated by the expansion in output of Pittsburgh Plate's tank blocks, open and covered pots, etc. Mr. Babcock recently resigned as Eastern Representative of the Laclede-Christy Clay Products Company. He is well equipped for his new duties. Starting with a Master's Degree in Ceramic Engineering, he was selected for the Silicate Fellowship at the Mellon Institute of Industrial Research and spent several years in original research on glasshouse refractories. He is well and favorably known in the trade, having for years called on the glass manufacturers.

Recent Deaths

Andrew J. Smith

Andrew J. Smith, president of the McKee Glass Company, Jeannette, Pa., died suddenly on April 10. Mr. Smith was born in Iowa sixty-eight years ago and went to Jeannette from Martin's Ferry, Ohio, in 1903 and at that time took over the Chambers and McKee glass interests and organized the McKee Glass Company. He is survived by his widow, two sons and two daughters.

George H. Wehr

George H. Wehr, assistant to the president and general superintendent of the Phoenix Glass Company, Monaca, Pa., died at his home in Rochester, Pa., on April 5. Mr. Wehr, who was 60 years of age, was formerly for some years superintendent of the etching and cutting departments of the Phoenix plant.

Matthew William Jack

Matthew W. Jack, president and general manager of the American Bottle Company, Streator, Ill., died at his home in that city on March 31, after a long illness. Mr. Jack was born in Old Chester, Pa., going to Streator in 1870. Some years later he became connected with the Streator Bottle & Glass Company, which later was developed into the American Bottle Company, with which he had been connected ever since.

Raymond M. Howe

Raymond M. Howe, vice-president of the American Ceramic Society, and prominent in ceramics, died at his home in Edgewood, Pa., on April 1. Mr. Howe was born in Elmira, N. Y., in 1894 and in 1915 received a B. S. degree from the New York State School of Clay Working and Ceramics, at Alfred, N. Y. During 1915-1916, he was Fellow at the University of Pittsburgh, receiving his A. M. degree in 1916 and acting as instructor in chemistry for a year. In 1917, Mr. Howe was appointed senior industrial fellow in the Mellon Institute of Industrial Research. At the time of his death he was connected with the Kier Fire Brick Company, of Pittsburgh, Pa. He is survived by his widow and three children.

RAYMOND MILLER HOWE

Mr. Howe was a valued member of the American Ceramic Society and over a period of several years held office as secretary of the Refractories Division, and as a member of the Board of Trustees. His election to the vice-presidency took place last February.

Coming Meetings

The Spring meeting of the **American Society of Mechanical Engineers** will be held at Cleveland, O., May 25 to 29.

The next meeting of the **American Society for Testing Materials** will be held at Atlantic City, N. J., June 23 to 28.

Society of Glass Technology. Sixth annual dinner, Hotel Cecil, London, May 27.

The annual meeting of the **National Glass Distributors' Association** will be held in Pittsburgh, Pa., during December, 1924.

The next **National Foreign Trade Convention** will be held at Boston, Mass., June 4, 5 and 6.

The Western Glass and Pottery Association will hold its next meeting at Pittsburgh, Pa., June 15.

The Summer meeting of the **American Ceramic Society** will take the form of a four weeks' trip to the Pacific Coast, leaving Chicago on July 21 and returning about August 16. Stops will be made at Spokane, Seattle, Lincoln, Cal., San Francisco, Los Angeles. A visit will be made to the Yosemite Valley and an opportunity given to visit the Grand Canyon.

The National Lime Association will meet on May 20, 21, 22, 23 at the Greenbrier Hotel, White Sulphur Springs, W. Va. The program will include not only a report of the activities of the association, but there will also be scheduled certain special features, including a golf tournament.

The **National Association of Manufacturers of the U. S. A.** will hold its annual meeting at New York City, May 19 to 21.

The annual meeting of the **National Ornamental Glass Manufacturers Association** of United States and Canada will be held at Atlantic City, June 24 to 26.

The **American Association of Flint and Lime Glass Manufacturers** and the **National Association of Manufacturers of Pressed and Blown Glassware** will hold their annual meetings at the Marlborough-Blenheim Hotel, Atlantic City, N. J., on July 14. The latter association, beginning July 16, will meet a committee of the American Flint Glass Workers' Union in a joint conference to consider the wage scales in the various branches of the industry for the ensuing year.

Inquiries Received

For further information address THE GLASS INDUSTRY

193. We should like the names of manufacturers of perfume and fancy frosted bottles. (March 27.)

194. Kindly give us a list of manufacturers specializing in machine-made glass jars (blown and pressed) and bottles, pharmaceutical and perfumery glass (phials, dispensing flats, stoppered rounds, etc.) and tumblers and household glass for export. (March 31.)

195. Where can we purchase diving glasses similar to ones used by pearl divers in the Pacific waters? (April 8.)

196. I desire the names of manufacturers of bird seed cups in clear and opal glass. (April 21.)

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Penna.)

PITTSBURGH STOCK EXCHANGE, APRIL 24, 1924.

	Bid	Ask	Last
American Window Glass Machine, common	88	90	88
American Window Glass Machine, preferred	93	94	93½
American Window Glass, preferred	106	107	107
Pittsburgh Plate Glass	225	235	230
U. S. Glass	...	24	23
Standard Plate Glass, common	26¼	27	26½
Standard Plate Glass, preferred (cumulative)	91	91½	92⅛
Standard Plate Glass, preferred (prior)	99½	100	99½

Trading was exceptionally light in the glass stocks during the past month on the Pittsburgh Stock Exchange. General business conditions and the weakness of the New York stock market caused liquidating sales that carried all issues to lower levels. Standard Plate sold ex-rights April 14, and receded from its high of 39 last month to 26¼. Pittsburgh Plate reacted 20 points to 230 on few trades.

WHEELING STOCK EXCHANGE, APRIL 24, 1924.

	Bid	Ask	Last
Hazel Atlas	...	31½	31½
Imperial Glass	...	90	90
Fostoria	140	...	150
Central Glass	...	110	110

The Wheeling market ruled quiet during the last month, holding the same price levels, with the exception of Hazel-Atlas, which fell from 34 to 31½ on active trading, with quite a few sales from 32½ to 31½.

TOLEDO STOCK EXCHANGE, APRIL 24, 1924.

	Bid	Ask	Last
Owens Bottle Machine, common	42⅜	43	42¼
Libbey-Owens Sheet Glass, common	92	96	..
Libbey-Owens Sheet Glass, preferred	107	(No Sales)	

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers

April 24, 1924		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	.06½	.07
Antimony oxide (Sb_2O_3)	lb.	.08½	.09½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.10½	.11½
Barium carbonate ($BaCO_3$) (precipitated)	ton	70.00	85.00
Barium hydrate ($Ba(OH)_2$)	lb.	.05	.05½
Bone ash	lb.	.06	.07
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.05¼	.06
Borax, fused ($Na_2B_4O_7$) any mesh	lb.	.19	.20
Boric acid (B_2O_3), fused	lb.	.35	.35
Cadmium Sulphide (CdS)—			
Red	lb.	..	1.60
Orange	lb.	..	1.65
Yellow	lb.	..	1.85
Chrome Oxide (Cr_2O_3)	lb.	.35	.36
Cobalt Oxide (Co_3O_4)—			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide—			
Red (Cu_2O)	lb.	..	.20
Black (CuO)	lb.	..	.25
Black prepared	lb.	..	.30
Cryolite (Na_3AlF_6)	lb.	..	.09⅛
Feldspar—			
100 mesh	ton	14.00-18.00	16.00-22.00
80 mesh	ton	15.00	18.00
40 mesh	ton	12.50	15.50
Ferrous oxide (FeO)	lb.	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	35.00	45.00
Hydrofluoric acid (HF) 60% (in lead carboys)	lb.	..	.13
Kaolin (f.o.b. mine)	ton	9.00	12.00
Lead Oxide (Pb_3O_4) (red lead)	lb.	.12	.12¼
Litharge (PbO)	lb.	.11½	.11¾
Lime—			
Hydrated ($Ca(OH)_2$) (in 50 lb. paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls. per bbl.		2.15	2.30
Magnesium carbonate ($MgCO_3$)	lb.	..	.09
Manganese 85% (MnO_2)	lb.	.03½	.03¾
Nickel oxide (Ni_2O_3), black, for nickel content	lb.	.32	.45
Nickel monoxide (NiO), green, for nickel content	lb.	.30	.50
Potassium carbonate—			
Calcined (K_2CO_3) 96%	lb.	.05¾	.06¼
Hydrated (KOH) 85%	lb.	.06	.06½
Potassium nitrate (KNO_3) (gran.)	lb.	.06½	.06¾
Potassium Permanganate ($KMnO_4$)	lb.	..	.14¾
Powdered blue	lb.	..	.24-.26
Standard formula	lb.	..	.32
Salt cake, glassmakers (Na_2SO_4), f.o.b. works	ton	23.00-25.00	30.00-40.00
Selenium (Se)	lb.	..	2.20-2.35
Soda ash (Na_2CO_3) dense, 58%— f. o. b. works.			
Bulk, spot Flat	100 lb.	1.40	..
Bulk, on contract Flat	100 lb.	1.35	..
In 400 lb. bbls., on contract.	100 lb.	1.69	..
In 300 lb. bags, on contract.	100 lb.	1.45	..
Spot orders .05 per 100 lbs. higher.			
Sodium nitrate ($NaNO_3$), refined (Gran.) in bbls	lb.	.04¼	.04½
Sodium selenite (Na_2SeO_3)	lb.	..	2.00-2.50
Sodium Fluosilicate (Na_2SiF_6)	lb.	.07	.07¾
Sulphur (S)—			
Flowers, 155 lb. bbl. Per	100 lb.	3.35	3.65-3.90
Flowers, in bags Per	100 lb.	3.00	3.30-3.55
Flour, heavy, in bbls. Per	100 lb.	2.50	2.55-2.80
Uranium oxide (UO_3), 100 lb lots	lb.	..	2.00-2.50
Zinc oxide (ZnO)	lb.	.08	.08¼

Monthly Summary of United States Foreign Commerce in Glass

Exports

Corrected to March 22, 1924.

	February 1923 Quantity	February 1923 Value	February 1924 Quantity	February 1924 Value	Eight Months Ending February 1923 Quantity	Eight Months Ending February 1923 Value	Eight Months Ending February 1924 Quantity	Eight Months Ending February 1924 Value
Glass and glass products (total)	.....	$800,607	.....	$678,778	.....	$5,996,933	.....	$6,817,350
Plate and window glass—								
Window glass, common, box 50 sq. ft.	2,519	13,220	1,334	10,269	20,925	119,457	36,400	162,355
Plate glass, unsilvered, sq. ft.	214,464	88,071	131,901	49,888	1,441,974	559,394	1,044,894	435,822
Other window and plate glass, n.e.s. lbs.	406,921	45,521	127,900	17,065	1,920,162	202,475	1,602,914	179,039
Glass containers (bottles, vials and jars) lbs.	4,522,634	232,422	4,617,729	210,877	35,235,409	1,804,031	44,092,774	2,113,978
Table glassware, plain lbs.	1,613,869	157,240	1,189,203	112,232	11,799,040	1,234,738	12,998,499	1,460,274
Table and other glassware, cut or engraved lbs.	31,748	11,216	21,844	7,932	374,164	145,378	372,010	122,452
Glass for lighting—								
Lamp chimneys and lantern globes lbs.	161,687	33,547	107,916	22,647	957,315	187,320	1,308,428	249,127
Globes and shades for lighting fixtures lbs.	127,595	38,927	84,814	26,710	1,059,861	293,316	1,184,462	320,568
Lamps and other illuminating devices, chiefly of glass lbs.	100,714	32,563	108,701	43,770	708,126	225,145	1,037,654	266,725
Chemical glassware lbs.	23,803	10,582	12,109	10,592	141,305	89,451	173,152	122,253
Electrical glassware, except for lighting lbs.	232,242	14,160	288,890	28,273	1,980,695	125,978	1,724,314	134,410
Other glassware, n.e.s. lbs.	599,541	123,138	1,245,998	138,523	5,576,201	1,010,250	8,057,999	1,250,347

Imports

Corrected to March 22, 1924.

	February 1923 Quantity	February 1923 Value	February 1924 Quantity	February 1924 Value	Eight Months Ending February 1923 Quantity	Eight Months Ending February 1923 Value	Eight Months Ending February 1924 Quantity	Eight Months Ending February 1924 Value
Glass (total)	.....	$1,517,801	.....	$1,576,102	.....	$11,274,873	.....	$17,217,213
Cylinder, crown, and sheet, lbs. dut.	.....	.....	.....	.....	[1]12,319,638	[1]560,973	.....	.....
Unpolished, lbs. dut.	2,866,327	105,538	2,355,536	151,288	[2]17,158,058	[2]738,746	25,111,370	1,256,818
Bent, ground, beveled, colored, painted, etc. and polished dut.	.....	29,808	.....	45,675	.....	[2]272,216	.....	507,684
Plate glass—								
Unsilvered, sq. ft. dut.	1,925,603	1,070,802	1,587,834	1,007,001	11,173,309	5,575,948	17,917,731	11,497,749
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft. dut.	144,171	32,022	137,098	19,398	[2]900,915	[2]175,649	1,490,779	234,585
Containers—bottles, vials, etc. dut.	.....	14,491	.....	13,650	.....	215,378	.....	98,720
Table and kitchen utensils, lbs. dut.	56,473	14,653	73,012	10,771	[2]454,248	[2]166,509	597,467	125,941
Glassware, cut or decorated, lbs. dut.	72,846	50,847	199,750	111,136	.....	1,190,560	2,584,260	1,141,638
Blown glassware, n. e. s., lbs. dut.	221,445	65,393	.....	.....	[2]2,119,196	[2]505,314	[3]3,402,894	[3]881,319
Bottles, ornaments, etc., lbs. dut.	.....	.....	137,939	55,368	.....	.....	[4]291,923	[4]116,036
Bulbs or electric lamps, lbs. dut.	.....	.....	315,918	11,271	.....	.....	[4]542,178	[4]13,960
Chimneys, globes, shades, etc., lbs. dut.	.....	.....	338,827	59,048	.....	.....	[4]621,461	[4]96,504
Articles and utensils for chemical, scientific, and experimental purposes, lbs. dut.	.....	.....	57,958	27,151	.....	.....	[4]114,196	[4]46,655
Other glassware free	.....	.....	.....	.....	.....	[4]44,253	.....	.....
Other glassware dut.	.....	134,337	.....	64,345	.....	1,829,327	.....	1,199,604

[1]July to Sept. 21, 1922. [2]Beginning Sept. 22, 1922. [3]July 1 to Dec. 31, 1923. [4]Beginning Jan. 1, 1924.